Radha Saraf

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EDUCATION

Worcester Polytechnic Institute(WPI) Worcester, MA | Jan'22 - Dec'23
MS. Robotics Engineering

PUBLICATIONS

Jain, A., Mahajan, M., Saraf, R. (2020). **Standardization of the Shape of Ground Control Point (GCP) and the Methodology for Its Detection in Images for UAV-Based Mapping Applications**. In: Arai, K., Kapoor, S. (eds) Advances in Computer Vision. CVC 2019. Advances in Intelligent Systems and Computing, vol 943. Springer, Cham.

PATENTS

Humanoid Robot, Patent Number: 517158

WORK EXPERIENCE

UNISON | SLAM Engineer Mountain View, CA | Mar'24 - Present

- Collaborated with the hardware team to address hardware-related questions that influence software, such as sensor specifications and placements for the VR headset.
- Integrated ORB SLAM 3 into the stack and addressed related issues such as transform misalignment and segmentation faults.
- Developed an algorithm for 3DOF pose estimation using IMU data from scratch.
- Developed algorithms/workflows for low-latency pose estimation, sensor fusion, calibration, optimization.
- Worked with the embedded team to make the early-stage prototypes of the VR headset functional.

HUMANE | Computer Vision Engineering Intern San Francisco, CA | Jun'23 - Nov'23

- Integrated hand **gesture recognition** feature using the MediaPipe model in an android application.
- Interfaced this feature with the Speech service of the application to speak when the gesture is recognized.
- **Animated** a rigged 3D hand model using joint transformations to optimize the rendering of laser effects onto the palm region, resulting in improved visual realism & interactivity.
- Trained a deep learning pipeline for **gesture classification**.

SKYDIO | Autonomy Engineer Intern- Computer Vision San Mateo, CA | Feb'23 - May'23

- Worked on enhancing **localization** accuracy of Skydio's Visual Positioning System (VPS), enabling more precise drone positioning.
- Used a sequence of images with relative pose constraints to refine the **optimization** problem for reducing VIO drift.
- Analyzed the **performance** on flight logs using sensible, intuitive metrics in the absence of ground truth data.

SKYLARK DRONES | Perception Software Engineer Bangalore, INDIA | Aug'18 – Nov'21

Perception for drone data:

- Developed an **object detection** algorithm for GCPs in aerial drone images, combining traditional computer vision tools with a CNN inspired by the LeNet model which resulted in **94.6%** accuracy(F-score).
- Achieved **86%** accuracy in estimating crop count for a farm using **machine learning** techniques(SVM, CNNs).

Drone Mission Planning and Operations:

- Primary **back-end** developer and maintainer for the in-house drone operations management application.
- Created multiple **RESTful** API endpoints and secured them with unit tests.
- Optimized several API routes to achieve **40-80%** reduction in latency using **MongoDB**
- Integrated **Celery** for background processing of time-consuming tasks like drone mission creation, elevation profile generation for areas of interest, etc.

IB HUBS | Product Development Intern Bangalore, INDIA | May'17 - Jun'17

- Carried out **camera calibration** and **pose estimation** of a 3D object for a Virtual Reality(VR) gaming application.

SKILLS

Languages: Python, C++, Matlab
Softwares: Linux, ROS, Gazebo, OpenCV, OpenGL, Blender, VS Code, PyCharm, Docker, Pytorch, Tensorflow, Git
Back end: MongoDB, Flask-RESTPlus, Postman, robo3t, Celery, AWS, Prometheus, Grafana

PROJECTS

3D Reconstruction of a scene using SfM and NeRF Github link — Python, OpenCV, Pytorch
Reconstructed a 3D scene from a set of images with different view points using CV & DL methods, **sfM** and **NeRF** resp.

Panorama stitching using CV and deep learning Github link — Python, OpenCV, Pytorch
Estimated homography between image pairs using **feature correspondences** and **HomographyNet**, a CNN based supervised learning architecture.

Deep q-learning to play breakout Github link — OpenAI, Pytorch
Implemented Deep QLearning Network(**DQN**) to play Breakout for an averaging reward over 40 points in 100 episodes.

Reinforcement learning techniques Poster link — OpenAI, Pytorch
Implemented Dueling DQN(**DDQN**), Asynchronous Advantage Actor Critic(**A3C**), Proximal Policy Optimization(**PPO**) techniques on Super Mario Bros. environment.

Zhang's camera calibration Github link — Python, OpenCV
Implemented Zhang's camera calibration method which resulted in a mean re-projection error close to **0.5 pixels**. Used **SVD** for getting an initial estimate of calibration parameters and Maximum Likelihood Estimation(**MLE**) for optimization.

Pose estimation of a mobile robot Video link — OpenCV, C++, ROS
Estimated pose of an autonomous mobile robot using differential-RGB color-space, image processing tools and **SolvePnP** algorithm from OpenCV library with an accuracy of **+/-5 cms**.

Autonomous mobile robot for library maintenance Video link — Python, ROS, RViz
Navigated turtlebot autonomously in a library using SLAM for identifying misplaced books with QR code detection.

Planning under nonholonomic constraints Github link — Python, Pygame
Developed a kinematic path planner with **nonholonomic constraints** to efficiently park several vehicles.

Graph search algorithms Github link — Python, Pygame
Implemented planning algorithms- **BFS, DFS, Dijkstra's, & A*** on a grid world setup of configurable obstacle density.

PID control of robot manipulator in ROS Github link — Python, ROS
Used ROS' client-service, publisher-subscriber frameworks for **PID control** of robot manipulator end-effector pose.

Face Swapping Github link — Python, OpenCV
Used two different approaches to swap faces in a video- Delaunay triangulation and Warping using Thin plate splines. Poisson blending was used to blend the faces.

Probability based boundary detection Github link — Python, Opencv
Developed an algorithm which finds boundaries by examining texture and color discontinuities in addition to intensity discontinuities across multiple scales.

E-braille reader Video link — C++, EagleCAD
Implemented capacitive touch mechanism for tactile feedback, established serial communication with bluetooth device, and designed a PCB circuit for a working prototype of the **E-Braille Reader** (a portable device that assists the visually challenged in reading).

COURSEWORK

Computer vision, **Motion planning**, **Robot controls**, **Reinforcement learning**

TEACHING EXPERIENCE

- Graduate tutor for MA2071: Matrices and Linear Algebra
- Graduate tutor for ECE2019: Sensors, Circuits and Systems
- Supervised and mentored high school girls throughout a 2-week, math day-camp at WPI, GirlsTalkMath, that explored mathematical concepts in **RSA Cryptography**
- Delivered lectures on **Linear Algebra** for sophomore students as part of the IvLabs mentorship program.
- Taken workshops on **PCB-designing** and **Basic electronics** for freshman students, under IvLabs, addressing a batch of 100-150 students at a time