RAHUL KARANAM

+1 (240) 726-3865 | rkaranam@umd.edu | linkedin.com/in/rahulkaranam | github.com/karanamrahul

EDUCATION

University of Maryland, College Park, MD | *M.Eng, Robotics* | *GPA – 3.8 / 4.0* August 2021 – May 2023(expected)

- Relevant Coursework: Software Development for Robotics, Perception for Autonomous Robots, Foundations of Deep Learning

SRM Institute of Technology, Chennai, India | *B. Tech, Mechatronics Engineering* May 2018

SKILLS & ABILITIES

Languages: Python, C++, MATLAB

Software Tools/Platforms/Practices: OpenCV, PyTorch, Keras/TensorFlow, Weights & Biases, Linux, Git, ROS, Gazebo, RViz, Gtest, Docker, CMake, TensorRT, AWS, Agile, TravisCI, Coveralls

Domain Skills: Computer Vision, Machine Learning, Deep Learning, Natural Language Processing

WORK EXPERIENCE

Jugaad Labs [link] – *Research Intern, Perception* Philadelphia, PA| May 2022 – Aug 2022

- Developed **end-to-end advanced driver-assistance system** in **PyTorch** using **CenterTrack** model for real-time **object detection and tracking** from **multiple camera feeds** in s**emi tractor-trailer fleets**.
- Incorporated **Kalman filtering** to handle and **update** internal **track state kinematics** for **externally detected vehicles**, achieving an average **precision** of **90%** on a **proprietary** dataset.
- **Optimized CenterTrack** model by **replacing CenterNet** backbone with **Harmonic Dense Net** for more efficient **edge computation**, resulting in a significant increase in **FPS** from **7 to 22**.
- **Pruned** model to reduce its size without compromising accuracy.
- **Trained** the **modified CenterTrack** model on proprietary dataset achieving **85% mAP**. **Deployed ONNX model** on **Nvidia Jetson NX and Nano** using **8-bit integer quantization** with **TensorRT** for edge computing.

Bio Machine Vision Lab [link] – *Graduate Researcher* College Park, MD| Apr 2022 – May 2022

- **Collaborated** with a team of researchers to **design**, **calibrate**, and **deploy** a **custom line scanning optical laser system** for accurately measuring the **depth of crabs** on a **conveyor belt.**
- Designed and implemented a **3D image reconstruction** pipeline for **depth detection** of **crabs** using **laser triangulation**, **Matrox Image Library (MIL) ,** and **detectron2**, achieving up to **98% detection** rates for **industrial** applications.

Apollo Tyres - Automation– *Senior Executive* Chennai, India | Dec 2018 – Mar 2021

- **Developed** and implemented a **vision-based** quality control system using **Sick cameras** and custom integration of **Mask R-CNN** and Sick's inbuilt **imaging library** to check for **defects** in **tire**s after **x-ray inspection**, achieving a **90%** accuracy rate. The system was built using Python, TensorFlow, Keras, OpenCV, and Sick's IOLink Master and Flexi Soft Safety Controllers
- Collaborated with a team to design and implement a **3D LiDAR system** for an **autonomous ground vehicle** used for **picking** and dropping **pallet**s in the **packaging area**. The system used **ROS** (Robot Operating System) to integrate the **LiDAR** data with the vehicle's **control system**, allowing for real-time mapping and navigation. The LiDAR sensors used were from **SICK**, and the control system was built using **C++** and **Python**.

TECHNICAL PROJECTS

- **Synthetic Data Generation using Diffusion Models [link]** | *Generative Modelling* | *Python, PyTorch*
  - Explored techniques for augmenting imbalanced datasets with **class conditioned** synthetic images generated using **Denoising Diffusion Probabilistic Models**.
  - **Evaluated** the **fidelity** of generated **synthetic data** by exploring its effects on a downstream task such as **image classification**.
- **Auto Eraser** [link] | *Mask Inpainting* | *Generative Modelling* | *Instance Segmentation* |*Python, PyTorch, OpenCV*
  - Developed a pipeline using **Mask-R-CNN** for **segmentation** models and **DeepFill V2** for **inpainting** functionalities to **remove objects** from **videos**. **Trained** the **pipeline** on **custom data** and achieved an **accuracy** of **85%**.
- **Lane Detection** [link] | *Perception for Autonomous Robots* | *Python, OpenCV*
  - Devised a **lane detection** & **turn prediction** system for self-driving cars using **Probabilistic Hough Transforms** and **morphological operations**.
- **Stereo Vision & Auto Calibration** [link] | *Visual Odometry* | *Python, OpenCV , numba*
  - Implemented **visual odometry** for a **stereo camera system** using **epipolar geometry** constraints and s**emi-global block matching**, resulting in accurate motion estimation between stereo camera frames.
  - **Camera calibration** using **Zhang's technique** was used to find **intrinsic** and **extrinsic** parameters and homography, and **reprojection error** was reduced using **Levenberg-Marquardt** non-linear optimization.
- **Augmented Reality** [link] | *Perception for Robotics* | Python, *OpenCV*
  - Developed a **detection pipeline** for **tracking** one or more **AR tags** in a video and **superimposing** a photo template or 3D cube on the **AR tag** for an AR/VR project using **homographic estimation**.