

Vaibhav Raheja

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WORK EXPERIENCE

Intelligent Motion Laboratory

Research Developer

Champaign, IL

August 2023 - December 2023

- Implemented advanced facial detection and analysis techniques using FaceMesh, OpenFace 1.0, and DeepFace for a robotic eye exam, enhancing accuracy by 28% in various scenarios. Head pose estimation using the ZED camera's depth tracking improved precision by 35%.
- Engineered and simulated a robotic arm, optimizing camera placement for effective 3D mapping, resulting in a 22% increase in detection accuracy and reducing untracked frames by 18% during comprehensive eye examinations.
- Utilized Fusion 360 to design robotic arm setups and camera mounts, achieving optimal facial coverage and maintaining consistent tracking in dynamic movement tests.

All India Institute of Medical Sciences (AIIMS) Hospital

Research Developer

Mumbai, India

February 2021 - May 2023

- Collaborated with a robotics team on an ICMR-sponsored intubation research project, achieving a 20% increase in procedural accuracy using advanced robotic techniques and machine learning algorithms.
- Designed a custom catheter and mouthpiece integrated with a high-resolution camera system, enhancing the success rate of intubations and improving patient safety through real-time visualization.
- Implemented the 'xArm 5' robotic arm, improving visualization and precision in intubation procedures, leading to better clinical outcomes.

EDUCATION

University of Illinois Urbana-Champaign

M.Eng Autonomy and Robotics GPA: 3.77

Champaign, IL

Graduation Date: December 2024

NMIMS' MPSTME

B.Tech Computer Engineering

Mumbai, India

June 2023

PROJECTS

Intelligent Ground Vehicle Competition (IGVC)

- Led a multidisciplinary group of 6 under Team D.A.R.V.I.N as captain in an international robotics competition in Detroit.
- Developed and optimized SOCRATES 2.0, achieving an average speed of 2.4 km/h with innovations such as a central drivetrain design, brushless hub motors, and adaptive sliding mode controllers for precise control and stability.
- Secured 2nd and 3rd place in the Cyber and Auto-Nav Challenge categories with advanced autonomous navigation, implementing lane and object detection combined with GPS navigation, achieving over 95% navigation accuracy and reducing obstacle collisions by 40%.

Autonomous Race Car

- Developed and implemented path planning algorithms for autonomous navigation on a Formula 1 racetrack in the CARLA simulator, utilizing Hybrid A*, Spline Interpolation, and Dynamic Programming, achieving a maximum score of 92.4 on the Shanghai track.
- Integrated a Proportional-Derivative (PD) controller with Pure Pursuit and a longitudinal controller for precise steering and speed control, reducing collisions to as low as 0 in some scenarios, and significantly improving performance and safety.
- Optimized path planning techniques, leading to a 40.8% improvement over baseline scores on the Shanghai track, demonstrating superior efficiency and reliability in autonomous navigation.

Reinforcement Learning using Dog Robot

- Utilized reinforcement learning to enhance Unitree Go1 robot control, surpassing the factory controller in adaptability and task efficiency by maintaining higher average speeds of 20% on uphill and gravel terrains.
- Executed real-world testing of RL models, optimizing robotic responsiveness and navigation precision, resulting in a 30% reduction in velocity tracking error compared to baseline models.
- Reduced power consumption during locomotion tasks by 25% on average compared to baseline factory settings, achieving higher stability and speed.

SKILLS

Programming: Python, C++, Robot Operating System (ROS), Gazebo, OpenCV, PyTorch, Machine Learning (ML), Convolutional Neural Networks (CNN), Simultaneous Localization and Mapping (SLAM)
Tools: Autodesk Fusion 360, Computer-Aided Design (CAD), Linux, Git, Arduino, Raspberry Pi, 3D Printing
Frameworks: Path Planning, Vehicle Control, Reinforcement Learning, Control Algorithms, Motion Planning Algorithms

PUBLICATIONS

Raheja, Vaibhav et al. (Nov. 2022). "Multi-Disease Prediction System using Machine Learning". In: *International Conference on Futuristic Technologies (INCOFT)*. URL: <https://ieeexplore.ieee.org/document/10094382>.