Vaibhav Raheja

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Education

University of Illinois Urbana-Champaign — Expected December, 2024
Master of Engineering in Autonomy and Robotics — GPA: 3.66 / 4
NMIMS MPSTME — June, 2019 – May, 2023
Bachelor of Technology in Computer Engineering — GPA: 3.66 / 4

Experience

Intelligent Motion Laboratory — August, 2023 – December, 2023
Robotics Research Developer — *Champaign, IL*

- Developed 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. Implemented head pose estimation using the ZED camera's depth tracking, improving precision by 35%.
- Designed 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.
- Engineered robotic arm setups and camera mounts in Fusion 360, ensuring optimal facial coverage and consistent tracking, reducing movement test errors and increasing accuracy in dynamic scenarios

All India Institute of Medical Sciences (AIIMS) Hospital — February, 2021 – May, 2023
Robotics Research Developer — *Mumbai, India*

- Led a robotics team on an ICMR-sponsored intubation research project, driving a 20% increase in procedural accuracy through the implementation of 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.
- Deployed the 'xArm 5' robotic arm, improving visualization and precision in intubation procedures, leading to better clinical outcomes.

Projects

Intelligent Ground Vehicle Competition (IGVC) | *Python, ROS, OpenCV, PID Control, Path Planning, CAD*

- 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 | *Python, Path Planning, Vehicle Control, CARLA Simulator*

- 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 | *Python, ISAAC Sim, RL*

- Enhanced Unitree Go1 robot control through reinforcement learning, achieving 20% higher average speeds on uphill and gravel terrains, surpassing factory controller in adaptability and task efficiency.
- 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++, OpenCV, PyTorch, Machine Learning (ML), Convolutional Neural Networks (CNN)
Robotics Frameworks and Tools: Robot Operating System (ROS/ROS2), Gazebo, Path Planning, Vehicle Control, Reinforcement Learning, Control Algorithms, Simultaneous Localization and Mapping (SLAM)
Tools: Autodesk Fusion 360, Computer-Aided Design (CAD), Linux, Git, Arduino, Raspberry Pi, 3D Printing

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.