# Anujith Muraleedharan

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## EDUCATION

**Rajiv Gandhi Institute of Technology**                                   **August 2018 – August 2022**
*Bachelor of Technology in Electronics and Communication Engineering GPA: 8.16/10 [Transcript]*                *Kottayam, India*

**Amrita Vidyalayam**                                                      **April 2014 – March 2017**
*Class XII AISSCE, CBSE; 85% ; Class X AISSE, CBSE; 9.8/10.0*              *Pandalam, India*

## RESEARCH EXPERIENCE

**Indian Institute of Technology, Delhi**                                  **June 2024 – Present**
*Research Associate Advised by Prof. M. Hanmandlu [Website]*              *New Delhi, India*

- Enhanced the eye-gaze-controlled robotic system for individuals with Severe Speech and Motor Impairments by incorporating safety protocols inspired by Asimov's Laws, utilizing a monocular camera for hand detection and path planning algorithms (MDP, RRT, BFS) to ensure safe operation.
- Developed a graph-based global path planner that dynamically generates real-time obstacle-free paths, ensuring collision prevention and seamless navigation around obstacles.
- Developing an autostereoscopic display system with 2D-to-3D video conversion using depth-based segmentation for improved depth perception and immersive viewing.

**Indian Institute of Science**                                           **August 2023 – May 2024**
*I3D LAB, Research Associate Advised by Prof. Pradipta Biswas [Website]*  *Bangalore, India*

- Developed and analyzed controllers (LQR, PD, Stanley, SMC), performed sensor fusion, and contributed to the robotic system development for an autonomous aircraft taxiing system [AVIATION Journal Vol 27 No 4 (2023)].
- Developed a comprehensive Eye-gaze-controlled assistive robotic system, including user interface design, control algorithm development, and hardware integration for a stamp printing application for individuals with Severe Speech and Motor Impairment [ACM IUI 2024].
- Designed and developed a six-wheel rover with a rocker-bogie suspension mechanism, capable of traversing 15% slopes while supporting a 25 kg payload
- Created customized inverse kinematics for the rover's 6-DOF robotic arm, utilizing its URDF and implementing a unique client-server HTTP firmware, eliminating the need for ROS 2 and reducing computational load by 30%.
- Worked on an ISRO-funded project focused on developing a Mixed Reality (MR) environment using Unity customized for the astronaut cockpit, aligning with preparations for the upcoming Gaganyaan mission.

**Rajiv Gandhi Institute of Technology**                                   **Jan 2021 – June 2022**
*CASP LAB, Undergraduate Research Assistant Guided by Prof. Manju Manuel [Website] [Certificate]*  *Kottayam, India*

- Tested and validated the Processing Element (PE) unit design within the Unified Winograd-GEMM (UniWiG) architecture, ensuring functionality through simulations in Vivado.
- Verified Modified Booth Encoding (MBE) multipliers and Wallace tree adders while analyzing power consumption and resource utilization to optimize performance metrics.
- Developed a functional prototype of a 3D holographic projection system using the Pepper's Ghost technique and a Raspberry Pi controller for interactive hand gesture controls, and optimized the Pepper's Ghost phenomenon by varying acrylic sheet tilt angle and thickness to enhance image quality.

## PUBLICATIONS

*Denotes Equal Contribution*

1. **Advancing Rehabilitation: Adaptive Robotic Arm for Safe Block Printing with Gaze Control**
   **Anujith Muraleedharan*, Anamika J H*, Madasu Hanmandlu
   *Springer International Journal of Intelligent Robotics and Applications* (**Under-review**)
   [Project Page]

2. **ACCESSIBILITY ANALYSIS OF EDUCATIONAL WEBSITES USING WCAG 2.0**
   Utkarsha Singh, Jeevithashree Divya Venkatesh, **Anujith Muraleedharan**, Anamika J H, KamalPreet Singh Saluja, Pradipta Biswas
   *ACM Digital Government: Research and Practice* [Paper]

3. **Eye-Gaze-Enabled Assistive Robotic Stamp Printing System for Individuals with Severe Speech and Motor Impairment**
   **Anujith Muraleedharan**, Anamika J H, Himanshu Vishwakarma, Kudrat Kashyap, Pradipta Biswas
   *ACM Conference on Intelligent User Interfaces (ACM IUI) 2024*
   [Paper]

4. **Developing a Computer Vision based system for Autonomous taxiing of Aircraft**
   Prashant Gaikwad, Abhishek Mukhopadhyay, **Anujith Muraleedharan**, Mukund Mitra, Pradipta Biswas
   *AVIATION Journal Vol 27 No 4 (2023)*
   [Project Page] [Paper]

## PROJECTS

**Get-3D** [Website]                                                        **August 2024 - October 2024**

- Designed and implemented a real-time 2D-to-3D video conversion system integrating YOLOv8 for instance segmentation and MiDaS for depth estimation, enabling dynamic depth-based effects.
- Implemented dynamic zooming, background masking, and selective focus adjustments, to enhance the depth perception.
- Improved 3D rendering accuracy through adaptive depth thresholding based on object depth and size.

**MDP-ValueIteration-Visualizer** [Website]                                 **June 2024 - July 2024**

- Developed an MDP-Value Iteration Visualizer to determine optimal navigation policies in a grid-based environment, with real-time visualization of utilities and agent paths.
- Implemented stochastic behavior control using the Bellman Equation with adjustable transition probabilities and utility smoothing for efficient and natural agent movements.
- Integrated features such as heuristic adjustments, random scenario generation, and performance metric logging, and optimal pathfinding.

**Human AV Interaction** [Website]                                          **Feb 2024 - May 2024**
*Associated with I3D Lab*

- Developed a system to extract lane coordinates, apply curve fitting, and calculate the middle lane, generating control inputs for autonomous UGV navigation.
- Implemented real-time fusion of proximity sensor data with person detection models to autonomously halt the UGV at safe distances.
- Mapped the detected person crossing the road and real-time wheel odometry data to a virtual simulation for accurate interaction with the pedestrian crossing with head-mounted displays.

**Interactive 3D Holographic Display** [Website]                            **Dec 2021 - Jun 2022**
*Undergraduate Thesis*

- Developed a 3D holographic projection system using the Pepper's Ghost technique to create illusionary 3D images by reflecting light on a semi-reflective surface, with interactive hand gesture control managed by a Raspberry Pi controller.
- Converted 2D frames to 3D by segmenting foreground objects from the background and integrated interactive 3D objects controlled by Leap Motion and OMNI Haptic, allowing for advanced interactions such as spawning, picking up, and coloring 3D objects.
- Explored optimization techniques for the Pepper's Ghost phenomenon to enhance image quality.

**Autonomous Racing: MPC vs. LQR** [Website]                                      **Dec 2020**
*Undergraduate Minor Project*

- Developed a Model Predictive Control (MPC) algorithm for vehicle trajectory tracking, integrating linear model approximations and optimizing state and control variables for real-time applications.
- Designed and implemented a reference trajectory generation system using waypoints interpolation and nearest neighbor indexing for accurate vehicle path following.
- Conducted simulations with PyBullet, showcasing the MPC algorithm's effectiveness in real-time vehicle control and trajectory tracking, including visualizing results and analyzing performance metrics.

## AWARDS

**Division of Mechanical Sciences Research Symposium** [Certificate]              **May 2024**
                                                                                *IISc Bangalore*

- Participated in the 3-minute Research Video Contest and got shortlisted among the top 10 out of 28 teams.
- Secured 4th position after the final round presentation.

**Technoxian World Robotics Championship** [Certificate] [Video]                   **July 2023**
                                                                                        *AICRA*

- Participated in innovation contest in which around 150 teams participated.
- Selected for finals presentation (top 10) at Noida NCR, India.

**Graduate Aptitude Test in Engineering (GATE)** [Scorecard]                  **February 2023**
                                                                                   *IIT Kanpur*

- Achieved an overall rank within the top 1.58 percentile among 70,361 candidates registered in the Electronics and Communication Engineering stream.
- Secured admissions to M.Tech. Programme in IISc Bangalore, IIT Madras, IIT Bombay and IIT Kharagpur.

## PROGRAMMING SKILLS

**Subjects of Interest**: Reinforcement Learning, Control, Robotic Vision, Machine Learning
**Languages**: Python, C/C++, C#, JavaScript, SQL
**Tools**: MATLAB, Fusion 360, GIT, Unity, Motive
**Frameworks**: ROS, TensorFlow, PyTorch, PyBullet

## SERVICE

**Prominence**                                                                 **January 2021**
*Chief Organizer*                                                          *Department TechFest*

- Organized a competition on fastest line follower robot with a total participation of 10 teams.
- Conducted a seminar on Solar Electric Propulsion.
- Organized a workshop on Advanced Driver Assistance Systems (ADAS).

**Intelligent User Interfaces (ACM IUI)**                                     **December 2024**
*Reviewer*                                                                        *Conference*

- Reviewer for the Posters and Demos track of ACM IUI 2025.

**Conference on Human Factors in Computing Systems (CHI)**                     **January 2025**
*Reviewer*                                                                        *Conference*

- Reviewer for the alt.chi track of CHI 2025.

## ONLINE CERTIFICATIONS

- ROS for Beginners: Basics, Motion, and OpenCV - Udemy
- ROS for Beginners II: Localization, Navigation and SLAM - Udemy
- ROS for Beginners III: Web-based Navigation with ROSBridge - Udemy
- Robotics and ROS - Learn by Doing! Manipulators - Udemy
- Robotics: Aerial Robotics - University of Pennsylvania
- TensorFlow for Deep Learning Bootcamp - Udemy
- Machine Learning and Artificial Intelligence - IIT Kanpur
- Python for Everybody - University of Michigan