GOKUL M K

IDDD in Robotics

📞 +91-9489360360 ✉ ed21b026@smail.iitm.ac.in 🔗 linkedin.com/in/gokul-m-k-886a93263 ○
github.com/gokulmk-12

EDUCATION

Indian Institute of Technology, Madras (CGPA 8.73)   Nov. 2021 – Present
Bachelor of Technology in Engineering Design, IDDD in Robotics (Interdisciplinary Dual Degree)   *Chennai, Tamil Nadu*

GRD Public School (Grade 12 CBSE (97.2 %), Grade 10 CBSE (93.8 %))   April 2007 – April 2021
Primary, Seconday and Higher Secondary   *Coimbatore, Tamil Nadu*

RELEVANT COURSEWORK

- Control Systems (ED2040)
- Introduction to Motion Planning (ED5215)
- Optimal Control (EE6415)
- (ED5315)
- Reinforcement Learning (CS6700)
- Introduction to Robotics (ID6040)
- Non-Linear System Analysis (EE6412)
- Data Science: Theory and Practice (ED5340)
- Analog and Digital Electronics (ED2130)
- Mechatronics System Design (ED5080)
- Introduction to Field and Service Robots
- Introduction to Motion Planning (ED5215)

RESEARCH EXPERIENCE, PROJECTS AND COMPETITIONS

Team Anveshak, Mars Rover Team, IIT Madras   June 2022 – Present
Embedded System Lead, Electronics and Software Engineer   *Chennai, Tamil Nadu*

- Focused efforts on the embedded systems of the rover's manipulator, gaining comprehensive experience in control systems and CAN interface integration. Delving into the realm of battery technology, the focus is presently on developing a bespoke battery management system tailored for the rover's needs.
- Engaged in the utilization of diverse **Visual SLAM** algorithms to address visual odometry and mapping requirements, culminating in the realization of autonomous navigation capabilities for the rover. These advancements have undergone rigorous testing within simulation environments.
- Developed a manipulator within the simulation environment to evaluate its functionality using the **ROS Moveit** Framework for diverse tasks such as obstacle avoidance with **OctoMap** and **grasp planning**. Engineered a tailored **IK solver** leveraging the capabilities of **PyKDL**, and presently integrating sampling-based motion planning algorithms for the manipulator.
- Conceptualized and proposed a pioneering solution for **harnessing energy from the southern ice polar caps on Mars** using the **Leidenfrost Effect**, a concept that garnered recognition and interest in the International Rover Design Challenge 2022.
- Finished **6th Globally** in the **Anatolian Rover Challenge, Turkey 2023** and **2nd** in the **International Rover Challenge, 2024**

Eyantra Robotics Competition 2023-24, IIT Bombay   Sep. 2023 – Jan. 2024
Geo Guide Theme Participant   *Chennai, Tamil Nadu*

- Participated in a 6-Month Long competition, collaborating within a team to develop an **Autonomous robot** proficient in maneuvering through an arena utilizing an overhead camera for navigation guidance. The arena simulated various events and accidents, requiring the robot to navigate to these locations.
- The arena features events detected by the overhead camera using **CNN**. The sequence of these events is communicated to the robot through a web server, initiating its mission.
- The robot is equipped with five IR sensors and operates on a differential drive system to navigate the lane. The positions of the events are indicated on the arena map using ArUco markers, which serve as GPS coordinates for navigation.
- The bot determines its path by **georeferencing** its location and selecting the closest ArUco marker to the event position. The objective is to visit the events in the most efficient order, prioritizing the **shortest path** and minimizing the time taken.

Eyantra Summer Intern, IIT Bombay   May 2023 – July 2023
Exploring Various Algorithms for Grasping Unknown Objects using a two finger gripper   *Powai, Mumbai*

- Conducted extensive research on the **Point Cloud Library**, harnessing its robust features to devise a **lightweight grasp detection method**. This approach estimates grasp poses based on **Euclidean Clustering and K-D Trees**, as viewed from an RGB-D camera.
- Integrated various grasping algorithms, including Graspnet, HAF, and GPD, with the Industrial UR5 Manipulator and OnRobot 2-finger gripper using **ROS**. Implemented these algorithms in both simulated scenarios in the Gazebo Simulation Engine and real-world hardware setups.
- Performed a comprehensive evaluation of the aforementioned algorithms through a series of experiments.Key evaluation parameters included accuracy, precision, estimation time, grasp success rate.

Eyantra Robotics Competition 2022-23, IIT Bombay   Sep. 2022 – Mar. 2023
AIR-4 Krishibot Theme   *Chennai, Tamil Nadu*

- Worked as a team in the programming of an **Autonomous Ground Vehicle (AGV)** tailored for navigating in a Greenhouse environment. The primary objective was to locate the targeted yield and employ a customized gripper mechanism for fruit plucking.
- Successfully implemented a **PD control** system, both in the **Gazebo simulation** environment and on **remote hardware**, to ensure precise lane keeping and trajectory correction during turns. This control system relied **solely on LiDAR Laserscan data** for decision-making.
- Worked in **Image Processing** and Centroid Detection using OpenCV, enabling accurate estimation of the fruit's position within the global frame. This critical step facilitated the AGV's ability to identify and target specific fruits.
- Leveraged the **Moveit motion planning framework** to autonomously control the onboard UR5 manipulator, orchestrating the plucking process.

COURSE PROJECTS

Trajectory Continous Optimal Planning using a Mobile Manipulator | *Motion Planning*   **Jan. 2024 - Present**

- The project seeks to use the expanded workspace provided by a mobile manipulator system, with experimental testing conducted using the **KUKA Youbot**.
- The concept involves continuously tracing a trajectory using **RRT*** while minimizing deviation in the end-effector pose through an **optimal control** formulation. Essential factors to consider include the precision of the performance measure, time efficiency, and success rate. This project shares similarities with 3D printing tasks performed by mobile manipulators.

Satellite Servicing Robot with Multi-Tool End Effectors | *MATLAB, Simulink, Fusion360*   **Jan. 2023 - May. 2023**

- Conducted research in the field of satellite rendezvous, **co-orbital Hohmann transfer**, and the precise time delays necessary for achieving flawless docking with the target satellite for servicing.
- Employed **MATLAB** to develop a **simulation model** illustrating the **orbital transfer patterns**, encompassing both coplanar and co-orbital scenarios."
- Contributed to the creation of a sophisticated 6-degree-of-freedom **harmonic geared manipulator**, designed for **precise docking and satellite servicing** applications.
- Conceptualized the strategy for **satellite de-orbiting** upon reaching the end of its operational life, enabling **controlled atmospheric re-entry** into oceanic bodies.

Optimisation of Maximum Stress Acting on an Automobile Part | *Simulia Abaqus*   **July. 2022 - Nov. 2022**

- Conducted a simulated analysis of plane stress on an automotive component welded at one end subjected to a distributed load, utilizing Abaqus.
- Performed optimization by introducing additional holes of varying sizes and shapes in a manner that ensures the maximum stress within the domain does not exceed 20% above the baseline value.

SCHOLASTIC ACHIEVEMENTS

- Achieved an **All India Rank of 6253** in the **JEE Advanced 2021** examination, surpassing a competitive pool of 1.5 lakh students nationwide.
- Attained the highest ranking within my school in the Grade 12 CBSE examination.

TECHNICAL SKILLS

Languages: Python, C, C++, Javascript, MATLAB, AVR Assembly Language

Software Tools: ROS/ROS2 (Robot Operationg System), Simulink, Git, Fusion360, Abaqus, Ansys Fluent, Gazebo,Arduino IDE, Altium

Libraries: Tensorflow, Pytorch, Scikit-learn, Drake, PCL

LEADERSHIP / EXTRACURRICULAR

School Pupil Leader   April 2019 – April 2020
GRD Public School

- Selected as the school pupil leader due to consistent performance in both academic and extracurricular endeavors during my higher secondary schooling.

School Throwball Player   April 2017 – April 2020
GRD Public School

- Selected as part of the core nine-member team for throwball, representing the school in three annual district-level competitions.
- Included as a member of the 9-player district team and secured the top position in the inter-state throwball competition.

School Football Player   April 2019 – April 2020
GRD Public School

- Selected as a member of the school's football team, where I positioned as the goalkeeper.

Karate Student   April 2015 – April 2018
GRD Public School

- Took part in the school's Karate program, achieving a double black belt and securing a bronze medal in a kumite tournament.

Robotics Workshop, Shaastra IIT Madras   January 2023
Team Anveshak, IIT Madras

- Organized and led a workshop, providing mentorship to over 50 students in the domain of robotics, specifically focusing on imparting knowledge about the tools and framework within the Robot Operating System (ROS).