CHARMIN PRITESH DESAI

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EDUCATION

The State University of New York at Buffalo (UB), NY, USA **Aug 2021 – May 2023**

- Master of Science in Robotics (Robotics & Artificial Intelligence)

Sardar Vallabhbhai Patel Institute of Technology (SVIT), Gujarat, India **Aug 2016 – Aug 2020**

- Bachelor of Engineering in Instrumentation & Control (Industrial Automation)

SKILLS

Programming Languages: C , Embedded C, Python, MATLAB & Simulink, Ladder Logic
Hardware: PLC, PID Control, Electrical, Electronics, Embedded Systems
Software: Machine Learning, Computer Vision, Image Processing, Robot Algorithms, ROS, Gazebo
Libraries: NumPy, Pandas, Matplotlib, OpenCV, TensorFlow, Sklearn, Keras

ACADEMIC PROJECTS

Autonomous Plant Watering Robot (ROS) **Sept 2022 – May 2023**

- **Objective :-** Developed an autonomous robot for watering plants in an unknown environment, facilitating SLAM Gmapping for creating occupancy grid. Further using A* path planning for generating a shortest path. Moreover, utilized AprilTags and robot's own velocity to localize the robot which is then used for plant searching and its pose estimation. Finally navigating to reach and water the plants effectively.

1. **SLAM :-** Used Gmapping on a TurtleBot3 robot in ROS gazebo to generate an image of size 384x384 pixels.
2. **Occupancy Grid :-** Performed image processing to generate an occupancy grid matrix of 400x400 pixels.
3. **Path Planning :-** Used homogenous transformation method to formulate two opposite coordinate frame transformations from Gazebo world frame to occupancy grid frame and vice-versa.
   Optimized A* algorithm from scratch and planned a 95% improved shortest path for the robot.
4. **Perception :-** Deployed AprilTags in gazebo. Executed AprilTag continuous detection node to derive the transform from any AprilTag's frame to robot's camera frame and world frame.
5. **Localization :-** Calculated the pose of the robot in the world frame with almost 100% accuracy.
   a) Updated robot's pose from AprilTag detection by a ROS Server-TF Broadcaster & Client-TF Listener node.
   b) Updated robot's pose using its own linear and angular velocity through trigonometric calculation.
6. **Recognition :-** Programmed a mathematical algorithm which estimates the true position of a plant from continuously updated robot's pose and robot to plant transform.
7. **Exploration :-** Robot explores the environment parallelly searching for plants to save their position in its memory.
   a) Programmatically came up with random points in the occupancy grid for robot exploration.
   b) Implemented K-Means Clustering algorithm with A* planning as a distance metric to cluster the points.
8. **Navigation & Control :-** Executed a controller node, driving the robot 80% faster from start to goal/plant location.
9. **Plant Watering :-** Enabled the robot navigating a shortest path for watering all the plants in least time.

Analysis of Fanuc LR Mate 200-iD Robot Arm **Sept 2021 – Nov 2021**

- Standardized position of 6-DOF robot manipulator's end-effector in base frame and world frame.
- Formulated calculations by Denavit-Hartenberg methodology and Forward Kinematics.
- Derived 6x6 Jacobian Matrix to generalize linear and angular velocities of end-effector using DH Table.
- Chose Euler-Lagrange method to derive a mathematical model of 6-DOF unit.

Controlled Silo Process using PLC **Feb 2018 – May 2018**

- Empty bottles run on a conveyor by a 1-phase motor belt until identified by a photo-switch sensor.
- This halts the motor and starts a LFM (liquid filling apparatus) for 3 seconds. Finally level sensor ends LFM.
- Conveyor is commenced again to fill new bottles; this repeated each cycle for 6 seconds.

Controlled Batch Mixer Process through PLC **Feb 2018 – May 2018**

- Two pumps pour distinct fluids into 1 container until stopped by a high limit level sensor.
- Then fluid mixture is heated and processed by a heater and spinning motor for a set timer of 30 seconds.
- Finally, an output valve opens, and a third pump supplies resultant fluid out in 10 seconds.
- Lastly, due to less fluid in container, so detected by low limit level sensor, two pumps turn on that repeat the cycle.

Embedded and Automation **2019 – 2021**

1. Invented miniature adapter to time any device/appliance from 1-99 minutes with automatic turn-off functionality.
2. Reconstructed an indoor automatic light system controllable in 4 ways (PIR/IR Remote/Phone/Ambient Light).
3. Created an automated concept which prevented water wastage and measured water consumption.

INTERNSHIP AND WORK EXPERIENCE

Teaching Assistant at University at Buffalo **Feb 2023 – May 2023**

- Teaching assistant of professor Dr. Vojislav Kalanovic (Program Director) in the course MAE594 Robotics 2.
  a) Conducted lectures on mathematical modelling of robot mechanisms and LABs on 6-DOF Jetmax Robot Arm.
  b) Simulated the robot on Gazebo and ran robot hardware via ROS-1 commands and programs.
  c) Calibrated 3 unalike end-effectors (electromagnetic suction cup, grippers, pen) with 1 AprilTag.
  d) Interfaced 5 different sensors like ultrasonic scan, display, dot matrix, touch, fan tracking, etc.

Grader Assistant at University at Buffalo **Sept 2022 – Dec 2022**

- Grader assistant of professor Dr. Minghui Zheng in the course MAE340 Dynamic Systems.

Internship at Tara Mechons Pvt. Ltd. **Apr 2020**

- Devised an Automatic Turn-Off Electrical Cutting System for operator safety in a team of 4 members.
  a) Interfaced 4-pole relay contactor to 3-phase induction motor that energized it.
  b) Lever when released, NC switch opened and disconnected the circuit that powered machine off.
  c) When lever was pulled, NC switch closed that completed this circuit, which turned mechanism on.

Internship at Larsen and Toubro Power Training **Jun 2019**

- Engaged in Training on Industrial Instrumentation and Control Systems.
  a) Learned about PLC, Ladder Logic programing, DCS, SCADA, industrial valves, and transmitters.
  b) Studied various motor starters. e.g., 2-3-4 point, VFD's, Soft starter and DOL starter.

Internship at Niyantras Automation **Dec 2018**

- Prototyped an Indoor Air Quality Monitoring System operating on Arduino, MQ135, and MQ5 sensor modules for detecting particulate matter, N2O, SO2, H2, LPG, CH4, CO, and alcohol.