CHARMIN PRITESH DESAI

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EDUCATION

MS in Robotics, University at Buffalo, Buffalo, New York, USA **Aug 2021 – May 2023**
Relevant Courses : Robot Control, Robot Algorithms, ROS, Machine Learning, Computer Vision
BE in Instrumentation & Control, SVIT College, Vasad, Gujarat, India **Aug 2016 – Aug 2020**
Relevant Courses : Industrial Measurement, Electrical Machines, Control, PLC, Embedded, Power Electronics & Drives

SKILLS

Programming Languages: Python, C , C++, Embedded C, PLC Ladder Logic
Hardware: PLC, PID Control, Electrical, Electronics, Embedded Systems
Software: Linux OS, MATLAB & Simulink, ROS & Gazebo, Data Structures & Algorithms
Libraries: NumPy, Pandas, Matplotlib, OpenCV, TensorFlow, Sklearn, Keras

WORK EXPERIENCE

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

- Worked with Dr. Vojislav Kalanovic (Program Director of Robotics) in the course MAE594 Robotics 2.
- Conducted lectures on mathematical modelling of robot mechanisms and LABs on 6-DOF Jetmax Robot Arm.
- Simulated the robot on ROS-Gazebo and ran robot hardware via ROS-1 commands and programs.
- Calibrated different end-effectors and interfaced different sensors to the robot arm.

Tara Mechons Pvt. Ltd. : Automation Intern **Apr 2021**

- Devised an Automatic Turn-Off Electrical Cutting System for operator safety in a team of 4 members.
- Interfaced 4-pole relay contactor to 3-phase induction motor that energized it.
- Designed the control circuit such that upon the pull and release of the lever arm the electrical machine turned ON and OFF respectively.

Larsen and Toubro : I&C Intern **Jun 2019**

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

Niyantras Automation : Automation Intern **Dec 2018**

- Prototyped an Indoor Air Quality Monitoring System that operated on Arduino, MQ135, and MQ5 sensor modules to detect particulate matter, N2O, SO2, H2, LPG, CH4, CO, and alcohol.

PROJECTS (AUTOMATION & CONTROL)

Fanuc LR Mate 200-iD Robot Arm

- 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.
- Chose Euler-Lagrange method to derive a mathematical model of 6-DOF unit.

PLC Project 1, Silo Process programmed through Ladder Logic

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

PLC Project 2, Batch Mixer Process programmed through Ladder Logic

- Two pumps pour distinct fluids into 1 container until stopped by a high-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, detected by low-level sensor, two pumps turn on again that repeat the cycle.

Industrial Temperature Measurement Circuit

- Designed and developed signal conditioning circuit using resistance temperature detector and operational amplifier.
- Connected RTD (PT100) temperature sensor to Wheatstone bridge and connected the output to IC741 Op-Amp.
- Calibrated the 0-100 °C range to 0-5 V output. Also developed its PCB through etching process.

DC Motor Control

- Controlled the speed of a 12V high torque dc motor, through a PID controller developed using IC741 Op-Amp.
- Wirelessly controlled the motor speed through a NodeMCU microcontroller and BC547 transistor.
- Used 2,3,4-point starters to start the dc motor.

PROJECTS (ROBOTICS & ARTIFICIAL INTELLIGENCE)

Autonomous Robot (ROS & Gazebo, View Project)

- **Objective :-** Developed an autonomous robot to work in an unknown environment. Facilitated by SLAM Gmapping to create occupancy grid. Used A* path planning to plan the shortest path. Utilized robot's own velocity and AprilTags for robot pose estimation and plant detection. Controlled the robot to navigate to plants.

1. **SLAM :-** Used Gmapping on a TurtleBot3 robot in ROS gazebo to generate an image of size 384x384 pixels.
2. **Mapping :-** 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. Enabled the robot to navigate the shortest path in the least possible time.

Face Detection and Clustering

- Implemented Face Detection on 100's of images using OpenCV and Python using Haar Cascade.
- Used KMeans Clustering algorithm to cluster the detected faces, an achieved a F1 score > 0.81 on test dataset.

Neural Network & CNN

- Buit a Neural Network on income dataset of size 32500 to predict a person's income. Achieved accuracy of 85.60 % through hyperparameter tuning for model optimization.
- Built a CNN on Fashion-MNIST dataset of size of 70000 images to predict the item type. Achieved accuracy of 92.05 % through hyperparameter tuning for model optimization.

Wall Detection and Motion Planning (ROS)

- Implemented RANSAC algorithm for a mobile robot to detect walls in an environment from laser scanner data.
- Performed motion planning with Bug2 algorithm from utilizing data passed by RANSAC node.

House Pricing Prediction (Linear Regression) and Gender Prediction (Logistic Regression)

- Analyzed data to forecast house prices in Boston based and achieved 94.8 % accuracy using linear regression.
- Made analysis on a penguin dataset for gender identification using logistic regression with 91% accuracy.