KULBIR SINGH AHLUWALIA

YouTube channel ⋄ GitHub ⋄ LinkedIn ⋄ Google scholar

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EDUCATION

Master of Engineering in Robotics *Aug 2019 - May 2021 (Expected)*
University of Maryland, College Park, USA GPA: **3.866/4**

B.Tech in Electrical Engineering *Aug 2015 - May 2019*
Punjab Engineering College, India GPA: **8.12/10**

EXPERIENCE

Univ. of Maryland, Robotics Algorithms & Autonomous Systems Lab *Jul 2020-present*
Independent study (Report), **Mentor: Dr Pratap Tokekar**

- Automated the task of constructing gazebo worlds for grass pastures where each plant has a unique pose and is scaled to match real world height data of a location.

- Point clouds of the pasture are obtained in the gazebo simulation for selected days of a year using LiDAR mounted on the hector quadcopter which is controlled using an autonomous navigation script.

University of Waterloo, Ontario, Canada *Mar-Jul 2018*
Visiting Scholar (Report), **Mentor: Dr Simarjeet Saini**

- Designed prototypes in Solidworks, which were 3D printed using the Ultimaker 3. Developed low-cost photonic devices like Urea in milk detector and the Fundus eye camera. The Fundus eye camera used Raspberry Pi3 to capture images and make videos of the retina of a model eye.

- Developed Orange sweetness detector which used Neural networks toolbox in MATLAB to predict sweetness of oranges.

Indian Institute of Technology, Roorkee *Jun-Jul 2016*
Research Intern (Report), **Mentor: Dr Dharmendra Singh**

- Varied the thickness of radio wave absorbers like nickel ferrite on a UAV model and its individual parts like cylindrical body, spherical nose and cuboidal wings and saw its effect on the Radar Cross Section in Ansys HFSS.

TECHNICAL SKILLS

Languages	Python, MATLAB, C++
Design	Blender, AutoCAD, Solidworks, Ultimaker Cura, Adobe Premiere Pro
Libraries	Numpy, Pandas, OpenCV
Other	Linux, Docker, ROS, Gazebo, RViz, Git, Doxygen, Simulink, Anaconda, LaTeX, MS Office

COURSEWORK

Graduate

- Decision making for robotics, Visual Learning and recognition, Planning for Autonomous Robots, Perception for Autonomous Robots, Control of Robotic systems, Robot modelling, Robot programming, Building Robot software systems

Undergraduate

- Neural networks and fuzzy systems, Advanced control systems, Microprocessors and interfacing, Power electronics, Mechatronics, Engineering analysis and design, Manufacturing, Biomedical engineering and Electromagnetic theory.

PROJECTS

Persistent-Monitoring using Multi-Robot (UAV-UGV) Coordination *Dec 2020*

Optimized a GestureGAN for resource constrained settings *Dec 2020*

Estimated the motion of a car using Visual odometry *May 2020*

Color segmentation using Gaussian mixture models & Expectation maximization *April'20*

Image Classification using CNN *May 2020*

Baxter transporting cubes in Gazebo *April 2020*

- Simulated a Baxter robot transporting cubes from one table to another in Gazebo using ROS Kinetic. The waypoints for moving the baxter arm were found out using Rviz. The gazebo world had custom designed obstacles which were avoided by the baxter arm.

Implemented A star algorithm for Path Planning on Turtlebot 3 *May 2020*

- This project uses A star algorithm to move the Turtlebot 3 from a start point to a goal area. The Turtlebot 3 is bound by non holonomic constraints and the user provides two values of RPMs for the wheels. The action set consists of 8 combinations of the two provided RPMs.

Turtlebot 3 with PID control *April 2020*

- Designed a PID controller for controlling a Turtlebot 3 in **Gazebo** using Ubuntu 16.04 and **ROS Kinetic**. It goes to the final position input by the user using a PID controller with adjustable gains and tolerances.

Path planning for point and rigid robot using Djikstra's Algorithm *April 2020*

AR-Tag detection - superimposed an image and virtual cube on an AR tag *March 2020*

Lane detection and Turn prediction for self driving car *March 2020*

- Developed an algorithm that used hough transform and histogram of lanes approach.
- Implemented homography and warp perspective functions from scratch to create overlays.

Tracked moving objects using Lucas-Kanade Tracker *April 2020*

Agile Robotics for Industrial Automation Competition (ARIAC) 2019 *May 2020*

- Developed an industrial system consisting of UR 10 robotic arms, conveyor belts and Autonomous Ground Vehicles (AGVs).
- The system could pick required parts from the conveyer belt, dispose faulty parts, assemble orders and deliver them using AGVs.

Modelled a UR 5 arm with Parallel Gripper in Rviz *Sep-Dec 2019*

- Simulated a **Universal Robots 5 arm using Moveit and Rviz** in Ubuntu 16.04 and ROS kinetic. The arm moved between poses pre defined in Moveit.
- Calculated the **DH parameters**, computed forward kinematics manually and verified the results using the **Peter Corke Robotics toolbox in MATLAB**. Simulation videos are available on my YouTube channel.

Designed a LQR and LQG controller for a gantry crane system *Dec 2019*

Teleoperated gesture controlled robotic arm *Aug 2018-May 2019*

- Engineered a prototype capable of transporting objects from one room to another using **web-based remote access** with **live video feed** and a gesture controlled robotic arm. With on-board power supply and a bright custom designed constant current LED light source, our robot was able to navigate through low light areas and locate objects even in a dark room.

- The robot could be controlled using any smart device and also had a speaker to play prerecorded messages to interact with people around the robot.

Handheld Orange sweetness detector using Neural networks *Mar-Jun 2018*

- The Orange sweetness detector used Near Infrared(NIR) Spectroscopy to detect the sweetness of oranges without cutting them and measuring BRIX content(sweetness) of their juice.

- It used a **Neural network in MATLAB** to predict the sweetness from the NIR data. The NN was trained on 400 Quarters of oranges and had an accuracy of 70%.

Fundus Eye Camera *Mar-Jul 2018*

- The Fundus Camera used infrared and visible white light to capture the image of the Retina to diagnose diseases like Diabetes and Glaucoma using a dual LED (infrared and white LED in one package) controlled via a touchscreen interface using a Raspberry Pi 3B.

- The entire **prototype** **was 3D printed**. Infrared light was used to focus the camera on the retina followed by a bright flash from the White LED to capture a coloured photograph of the retina of a model eye.

Pick n place transporter bot *Aug-Dec 2016*

- 4 by 4 bot built using relays, limit switches, rack and pinion. It had a minimum movement of 3mm (gripper) and 5mm (base of the bot). This robot won numerous competitions in IIT Bombay, IIT Roorkee and Punjab Engineering College (PEC).

Smart Garden *March 2017*

- This project stood first in Texas Instruments hardware hackathon and consisted of a smart water sprinkler, energy saving lights which adjusted light output in accordance with ambient light and a dustbin that gave SMS alerts when full.

RESEARCH ARTICLE

- The multispectral Fundus Eye camera prototype was featured in the Optics and Photonics News (OPN) in February 2019 in "Saini, Simarjeet Singh, Aneesh Sridhar, and Kulbir Ahluwalia. "Smartphone optical sensors." Optics and Photonics News 30, no. 2 (2019): 34-41."
  Link: https://doi.org/10.1364/OPN.30.2.000034

CONFERENCE PRESENTATION

- Li, Yuqi, Kulbir S. Ahluwalia, and Simarjeet S. Saini. "Reinforcement learning integrated with supervised learning for training of near infrared spectrum data for non-destructive testing of fruits (Conference Presentation)." In Sensing for Agriculture and Food Quality and Safety XII, vol. 11421, p. 114210J. International Society for Optics and Photonics, 2020.
  Link: https://doi.org/10.1117/12.2557416

TEACHING EXPERIENCE

- Taught Math and Science to government high school students as part of "PUNARKRITI Welfare Society" (Jan-Apr 2016) and "Junior Einstein" (Dec 2018) social welfare organizations.