Sahib Singh Dhanjal

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Education

University of Michigan, Ann Arbor Sep 17 – Apr 19

Masters of Science in Robotics | GPA - 3.55/4.00 | **Courses**: Artificial Intelligence, Machine Learning, SLAM, Self Driving Cars, Computer Vision

Birla Institute of Technology and Science, Pilani Aug 12 – Jun 16

Bachelors of Engineering in Mechanical Engineering | GPA - 9.05/10.00 | **Courses**: Image Processing, Mechanisms in Robotics

Technical Skills

Languages:	Python, C/C++, JavaScript (Proficient); MATLAB, Java, HTML, CSS, Latex (working knowledge)
Technologies:	Git, Tensorflow/Keras, ROS, OpenCV, Android Studio, Django, Linux, PyTorch, GTSAM
Software:	Solidworks, ANSYS, Fritzing, Adobe Creative Suite, Microsoft Office Suite, Processing
Hardware:	TurtleBot v2, Fetch, AION R1 Rover, Crazyflie 2.0, Velodyne HDL32, Flir Ladybug 5, Kinect, Hololens, Oculus Rift, Vicon
Fabrication:	Skilled in mechanical design, fabrication and prototyping. Comfortable in circuit design and testing procedures.

Work Experience

ExxonMobil Chemicals | Sales Assistant – South Asia Jun 16 – Jul 17

- Handled India and subcontinent operations for EM's largest global distributor. Managed portfolio of 12 customers
- Implemented custom dashboard which led to increase in sales performance by 15% and the analytics efficiency by 65%

PEPL Lab, University of Michigan |Search Engine Optimization Oct 17 – Nov 17

TATA Steel | Quality Control Intern May 14 – Jul 14

Research Experience

Perpetual Robotics Lab : *Visual-Radio-Inertial Positioning System* Aug 18 – Current

- Developed a radio-visual-inertial localization framework for indoor and GPS denied environments
- Implemented neural network in Keras to classify LOS/NLOS packets to validate application for Friis Free Space Model (95% accuracy)
- Simulations developed in MATLAB and Python and experiments being done on Fetch Mobile Manipulator
- Keywords – deep learning, WiFi localization, ORB-SLAM, Fast SLAM, sensor fusion

Distributed Aerospace Systems and Controls Lab : *NASA Astronet, TARDEC Project, ICRA '19* Apr 18 – Current

- Developed control algorithms for NASA's Astronet project. VR simulations for the same were developed for the ISS in Gazebo.
- Developed an unsupervised learning approach for multi-tasking environments and used Microsoft Hololens to provide augmented vision of the not-in-focus tasks using a quadrotor streaming video feed. Work submitted for ICRA '19
- Working on multi-robot localization and collision avoidance algorithms with a swarm of Crazyflies and AION R1 rovers
- Keywords – unsupervised learning, swarm localization, AR, Virtual Reality, Microsoft Hololens, Oculus Rift, potential functions, control

Technical Projects

Deep Learning based Vehicle Classification and 3D Bounding Box Regression Oct 18 – Dec 18

- Implemented 20-Layer SE-ResNet deep neural network in PyTorch for vehicle classification on the GTA 10k dataset (accuracy ~73%)
- Developed a 3D Bounding Box Regression algorithm using YOLO v3 to produce segmented images with corresponding 2D/3D bounding boxes
- Placed #5 (out of 41) in the competition | Keywords – SE ResNet, object detection, GTA 10k dataset, PyTorch, YOLO

SLAM and Object Detection for an Autonomous Surface Vessel Jan 18 – Oct 18

- Developed Software Framework for sensor fusion between Spatial Dual GPS/IMU module, FLiR Ladybug 3 and 2 Velodyne HDL-32E
- Implemented Robot Control Algorithms and YOLO based marker detection system (as per competition guidelines)
- Worked on Multi-Lidar and Camera Calibration using 3D-3D point correspondences algorithm
- Implemented SLAM Framework in ROS using gmapping, costmap-2d, and amcl library
- Keywords – deep learning, SLAM, sensor fusion, lidar/camera calibration, ROS, OpenCV, YOLO, Velodyne, GPS

Unsupervised Learning of Assistive Camera Views in Augmented Reality Multitasking Environments Jul 18 – Sep 18

- Devised an unsupervised learning algorithm by which an aerial co-robot streamed assistive camera views which are unknown a-priori
- Research work submitted for the ICRA 2019 Conference
- Keywords – multi-agent control, Expectation Maximization, AR, ROS, OptiTrack, rViz, Gazebo

NASA Astronet - A human centric network of Astrobee robots May 18 – Aug 18

- Bayesian inferred control algorithms for local and global multi-agent coverage of a confined space
- Each agent (Astrobee) capable of operating autonomously, and manually as per gesture commands
- VR environment of the International Space Station with multiple robots created. Operator capable of walking inside and operating robots
- Keywords – autonomous exploration, multi-agent control, NASA Astrobee, Oculus Rift, ROS, VR, OptiTrack, rViz, Gazebo

Deep Learning in Localization and Mapping (PoseNet + SfM) Feb 18 – Apr 18

- Deep Learning based structural motion generation algorithm used to automatically label mobile camera input
- PoseNet is trained on the above labeled data and is used as the sensor model. GPS/Odometry data used as action model
- Simulation on GTSAM and implementation on a differential drive mobile robot
- Keywords – SLAM, Deep Learning, PoseNet, Structure from Motion, OpenCV, TensorFlow, GTSAM

Mask R-CNN based Online Pedestrian Tracking System Feb 18 – Apr 18

- Transfer learning on Matterport Mask R-CNN for pedestrian detection
- Particle Filtering based on optical flow used to track the trajectory of each of the pedestrians
- Keywords – Localization, Deep Learning, Mask R-CNN, TensorFlow, Keras, OpenCV

Robot Kinematics Simulator and Motion Planner Sep 17 – Dec 17

- Forward kinematics using matrix stack & DH convention implemented based on URDF structure of the robot (model for Fetch available)
- Inverse Kinematics simulated using cyclic coordinate descent and gradient descent using manipulator jacobian implemented
- RRT/ RRT-Connect/ RRT-Star planner implemented for high dimensional motion/ trajectory planning
- Keywords – Serial Manipulation, Trajectory Planning, Simulator, Fetch

SLAM and autonomous exploration in differential drive robot Oct 17 – Dec 17

- Programmed a mobile robot in Raspberry Pi 3 to perform SLAM (Simultaneous Localization and Mapping) using a 2D Lidar
- Implemented Monte Carlo Localization (particle filter) to estimate robot position in a map
- Implemented occupancy grid mapping to map unknown environment to known robot poses
- Implemented A* for path planning and Yamauchi's algorithm for autonomous exploration algorithm on the robot
- Localization results within 5% accuracy of the ground truth. Keywords – SLAM, LiDAR, Mapping, Localization, LCM

Vision based autonomous 4-DOF dynamixel robotic manipulator Sep 17 – Oct 17

- Developed a block detection system in OpenCV on images and depth-maps streamed from an overhead Microsoft Kinect
- Used a chessboard to calibrate the camera in OpenCV, implemented affine transformation to align RGB and Depth Cameras and solved the PnP problem in OpenCV to align the camera and the world frames
- Processed data was used to manipulate a 4-DOF dynamixel arm autonomously to complete tasks such as block stacking based on color and building 5-level pyramids | Keywords – OpenCV, Kinect, LCM, serial manipulation, Object Detection

Path planning and multi-robot autonomous exploration on Turtlebot Dec 15 – May 16

- Path Planning / Navigation stack developed for Turtlebot on ROS Indigo
- Python simulator developed for simulation of multi-robot autonomous exploration and path planning algorithms
- Simulation of autonomous multi-robot exploration in Gazebo. Project was sponsored by DRDO, India
- Keywords – ROS, navigation, exploration, multi-robot, path planning, A*, JPS, Yamauchi, Burgard exploration

Vehicle Suspension design for a Formula Student Prototype – FSAE Italy Oct 12 – Sep 14

- Responsible for design and fabrication of a suspension package for a formula student prototype
- Worked on bell crank geometry, double wishbone suspension design, dynamic roll center migration, spring and roll rates for the car, anti-dive and anti-squat parameters for the car
- Team achieved a global 8th place in Design out of 47 teams in FSAE Italy 14 | Keywords – Suspension design, SolidWorks, ANSYS, Msc Adams

Gesture controlled robotic arm Oct 14 – Dec 14

- Gesture controlled 4-DOF serial manipulator fabricated to augment human capability
- The arm was controlled using 2 Arduino UNOs, IMUs for gesture tracking and an XBee module for wireless communication

Design/ Fabrication of an autonomous white-board cleaner May 15 – Jun 15

- Autonomous serial manipulator fabricated which was capable of wiping boards of numerous sizes
- Research paper on this work presented at IEEE UPCON 15

SVM based spam-mail classifier Oct 15 – Dec 15

- Spam mail classifier based on Support Vector Machine modeled in MATLAB with accuracy in classification of 96.3%

Publications/ Conferences

Unsupervised Learning of Assistive Camera Views in Augmented Reality Multitasking Environments: ICRA 19 (submitted)
Design and development of board cleaning serial manipulator: IEEE UPCON 15

Positions of Responsibility

CoStAA (Techfest Coordinator) Mar 14 – Apr 15

- 1 of 7 people solely responsible for managing APOGEE, BITS Pilani's Annual TechFest (2nd largest in Asia)
- Managed and coordinated the work of 50+ clubs and departments comprising of 2200+ student members
- Raised funding of 20 lakh INR for sponsorship of all events
- Witnessed participation of 5000+ students from through out India

Festival Coordinator - Aarohan Mar 14 – Apr 15

- Gesture controlled 4-DOF serial manipulator fabricated to augment human capability
- The arm was controlled using 2 Arduino UNOs, IMUs for gesture tracking and an XBee module for wireless communication

Department Coordinator - Department of Visual Media Dec 13 – Apr 15

- Gesture controlled 4-DOF serial manipulator fabricated to augment human capability
- The arm was controlled using 2 Arduino UNOs, IMUs for gesture tracking and an XBee module for wireless communication

Marketing and Vehicle Dynamics Lead - Formula Student Team July 13 – Sept 14

- Raised sponsorship of 5 lakh INR for fabricating vehicle
- Designed, printed and sold over 2500 T-shirts as an effort of securing funds for the team
- Responsible for designing and sending out monthly newsletters and sponsorship brochures to sponsors
- Managed a brilliant team of 15 student engineers, who designed the whole suspension system of the vehicle : from the wheel hubs to pushrod suspension system

Achievements

- Won Track-O-Mania, Junkyard Wars, iStrike (vision based autonomous robot competition), APOGEE '14
- Won the Google Udacity Scholarship for Android Development
- Won iBOSM '14 soccer and volleyball tournaments
- Represented East Singhbhum district soccer team

Extra - Curricular

- Taught Robotics, Algorithms, and Mechanical Engineering on Chegg Tutors
- Front-end developer - APOGEE '15 | Aarohan '15 | Inspired Karters | Department of Visual Media
- Lead animator and web-designer, Department of Visual Media, BITS Pilani
- 2nd in BITS Premier Soccer League