Sahib Singh Dhanjal

Linkedin: sahibdhanjal | Github: sahibdhanjal | Portfolio: sahibdhanjal.github.io | Email: sdhanjal@umich.edu | Phone: (734) 239 2285

Education

MS: Robotics, Automation and Mechatronics *(GPA - 3.55/4.0) - University of Michigan, Ann Arbor* — Sep 17 – Apr 19 (*expected*)

B.E(Hons): Mechanical Engineering *(GPA – 9.05 /10) (Ranked top 10 in batch) – BITS, Pilani (#5 in India)* — Aug 12 – Jun 16

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
Hands-on:	TurtleBot v2, Fetch, AION R1 Rover, Crazyflie 2.0, Velodyne HDL32, Flir Ladybug 5, Kinect, Hololens, Oculus Rift
Fabrication:	Skilled in mechanical design, fabrication and prototyping. Comfortable in circuit design and testing procedures. *Strong implementation skills (have solved 500+ problems on various online judges)*

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

Ongoing Projects

Visual-Radio-Inertial SLAM — Aug 18 – Current

- Developed a system for fusing Visual Odometry from ORB-SLAM, IMU Readings and WiFi RSSI data for GPS Denied Localization
- Implemented Deep Neural Network in Keras to classify LOS/NLOS packets to validate application for Friis Free Space Model.
- Simulation of front-end algorithm using Fast SLAM v1 and back-end using GTSAM (iSAM2) built in MATLAB
- Currently implementing model on the Fetch Robot in ROS | Keywords – deep learning, WiFi localization, ORB-SLAM, Fast SLAM, sensor fusion

Multi-Agent Mapping, Task Allocation and Control — Aug 18 – Current

- Implementing Algorithms for multi-robot mapping for ground vehicles using multiple AION R1 Rovers
- Implementing multi-agent task allocation and coordination algorithms for multiple CrazyFlies and AION R1 Rovers for surveillance and mapping
- Keywords – Multi-Agent Mapping, LiDAR, ROS, Multi-Agent Control

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 38) 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

- Implemented the occupancy grid mapping algorithm, action model, sensor model, and particle filter for SLAM (in C/C++)
- Implemented Yamauchi's 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
- 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

Formula Student – 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%

Coursework

Graduate/ Undergraduate: Design & Analysis of Algorithms, Foundations of Computer Vision, Mobile Robotics, Machine Learning, Robot Kinematics & Dynamics, Machine Learning, Artificial Intelligence, Self-Driving Cars, Data Structures and Algorithms, Image Processing, Deep Learning

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