Sahib Singh Dhanjal

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Education

MS: Robotics, Automation and Mechatronics *(GPA - 3.56/4.0) - 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, Machine / Deep Learning, Robot Operating System, OpenCV, Unity, Android Studio, Django, MongoDB
Software: Solidworks, ANSYS, Fritzing, Adobe Creative Suite, Microsoft Office Suite, Processing
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

AUVSI RobotX - Autonomous Surface Vessel Competition — Jan'18 – Current

- Sensor fusion between Spatial Dual GPS/IMU module, FLiR Ladybug 3 and 2 Velodyne HDL-32E
- Multi-Lidar and Camera Calibration using 3D-3D point correspondences algorithm
- YOLO v3 based marker detection system (object+color) (as per competition guidelines)
- Jump Point Search (JPS) implemented for path planning
- Simulation environment created in Gazebo with localization and performance accuracy within 1m of commanded position on water
- Keywords – Deep Learning, MPC, Path Planning, Sensor Fusion, TensorFlow, OpenCV, ROS, PyTorch, Camera Calibration, YOLO

Projects

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
- Algorithms implemented on NASA's Astrobee Simulator as well as quadrotors
- VR environment of the International Space Station with multiple robots created. Operator capable of walking inside and operating robots
- Project under the guidance of Dr.Dimitra Panagou and allocated to the NASA ECF grant
- 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, PoseNet, Structure from Motion, OpenCV, TensorFlow, GTSAM

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, Computer Vision, Mobile Robotics, Machine Learning, Robot Kinematics & Dynamics
Online/ Self: Deep Learning, Self-Driving Cars, Data Structures and Algorithms, Intro to Networks, Artificial Intelligence for Robotics

Publications

Design and development of board cleaning serial manipulator: IEEE UPCON '15

Positions of Responsibility

- *CoStAA (Techfest Coordinator*), APOGEE'15, Annual tech fest of BITS Pilani
- *Festival Coordinator*, Aarohan'15, an outreach initiative by BITS Pilani
- *Department Coordinator*, Department of Visual Media, BITS Pilani
- *Marketing Head*, Inspired Karters, BITS Pilani
- *Vehicle Dynamics Head*, Inspired Karters, BITS Pilani

Achievements

- Placed 8th in ACM ICPC Amritapuri Regional '13 and 12th in ACM ICPC Calcutta Regional '14
- AIR# 6350 out of 1,500,000 applicants in IIT-JEE 2012, India's most competitive engineering exam (~2% acceptance rate)
- Won Track-O-Mania (a line following bot competition), iStrike (vision based autonomous robot competition), APOGEE '14
- Won Junkyard Wars, APOGEE '15
- Won iBOSM '14 soccer and volleyball tournament and represented East Singhbhum district soccer team
- Cleared Regional Maths Olympiad 2010

Extra - Curricular

- Taught Robotics, Algorithms, and Mechanical Engineering on Chegg Tutors
- Front-end developer for main-site APOGEE'15
- Lead web-developer for the Formula Student team - Inspired Karters, BITS Pilani
- Animator and web-designer, Department of Visual Media, BITS Pilani