

# Kunal Nandanwar

Reno, Nevada - 89521

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## EDUCATION

<b>Worcester Polytechnic Institute, Worcester- MA</b> <i>Master of Science in Robotics</i>	Aug 2021 - May 2023
<b>Birla Institute of Technology &amp; Science, Pilani- India</b> <i>Bachelor of Engineering(Hons.) in Mechanical</i>	Aug 2015 - Jul 2019

## PATENT & DISCLOSURES

• <b>Nandanwar, K.</b> Javed, H. Jamali, N. 2023. <i>SYSTEM &amp; METHOD FOR COMPLETING THREE DIMENSIONAL FACE RECONSTRUCTION</i> (Under review-USPTO)	
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## WORK EXPERIENCE

<b>FieldAI - Autonomy Intern</b>	Jul 2023 - Aug 2023
<ul style="list-style-type: none"><li>Implemented optimal scan positioning for an automated scanning process with an autonomous robot platform using BIM models</li><li>Worked with Business Development &amp; Product teams to understand customer needs and translate them to engineering requirements</li></ul>	
<b>Vecros Aerial Robotics - Autonomy Intern</b>	Jan 2023 - May 2023
<ul style="list-style-type: none"><li>Incorporated 2-phased novel techniques for autonomous image capture for improved accuracy &amp; efficiency of reconstruction process</li></ul>	
<b>Honda Research Institute, San José - Machine Learning Intern</b>	Sept 2022 - Jan 2023
<ul style="list-style-type: none"><li>Worked on the human-understanding model for Avatar robot designed by Honda Research Institute for human-robot interaction</li><li>Collected &amp; analyzed human behavioural data; estimated human satisfaction level in human-robot interaction using transfer learning</li></ul>	
<b>Brain Corporation, San Diego - Robotics Intern</b>	May 2022 - Aug 2022
<ul style="list-style-type: none"><li>Worked with Robot Autonomy Team to classify items in the warehouse for smart-robot pick-up &amp; delivery</li><li>Used YOLOv5 pre-trained architecture, COCO dataset along with custom images, predicted available stock &amp; created bounding boxes</li></ul>	
<b>John Deere, India - Engineer II</b>	Jul 2019 - Jul 2021
<b>Design Engineer:</b> <ul style="list-style-type: none"><li>Worked closely with product development cycle &amp; developing agricultural narrow tractors for American and European markets</li><li>Designed sheet metal parts, routed oil lines, hoses and electrical harnesses using CREO; supervised quality of manufactured parts</li><li>Analysed safety norms &amp; standards by different countries for tractors; performed durability tests &amp; diagnosed mechanical systems</li></ul>	
<b>Software Perception Engineer:</b> <ul style="list-style-type: none"><li>Contributed in design for vision-based automated rear &amp; front implement-attachments for autonomous sprayers &amp; tractors</li><li>Developed ML-based computer vision model for traffic signal detection with 92% precision &amp; for weed detection with 88% precision</li><li>Created a CREO program using C++ to create 32 rear-wheel configurations, reducing design time by around <b>20x</b></li></ul>	
<b>Software Engineer:</b> <ul style="list-style-type: none"><li>Developed a Disease Detection Mobile Application for farmers using CNN and TensorFlow, enhancing agricultural practices</li><li>Implemented advanced image classification and data augmentation techniques, ensuring accurate plant disease detection</li><li>Engineered seamless user experience with React JS &amp; Native, integrated TensorFlow Serving, FastAPI, &amp; optimized model deployment on GCP</li></ul>	

## RESEARCH EXPERIENCE

<b>DiCE Lab, San Diego State University - Research Assistant</b>   <a href="#">Presentation Link</a>	Sept 2023 - Present
<ul style="list-style-type: none"><li>Working to develop an automated framework for optimizing scan planning in stop-and-go mapping procedures</li><li>Utilizing Building Information Modeling (BIM) data to enhance the scan planning process for a quadruped walking robot</li></ul>	
<b>Eversource Energy &amp; WPI - NSF Graduate Research Fellow</b>   <a href="#">Video Demo Link</a>	Jan 2023 - Aug 2023
<ul style="list-style-type: none"><li>Responsible for designing an autonomous robot that can patrol cables to deter birds from congregating near utility assets</li><li>Deployed custom trained deep learning model on Jetson Nano powered robot; integrated camera &amp; Time of Flight sensors using ROS</li></ul>	
<b>Manipulation &amp; Environmental Robotics Labs, WPI - Research Assistant</b>   <a href="#">Presentation Link</a>	Jan 2022 - May 2022
<ul style="list-style-type: none"><li>Developed 3D motion planner using A* algorithm for different motion primitives considering their cost of traversal</li><li>Designed a parallel variable friction gripper model for improved object manipulation with precision control along object-surface</li></ul>	
<b>BITS Pilani, India - Research Assistant</b>   <a href="#">Presentation Link</a>	Aug 2018 - Dec 2018
<ul style="list-style-type: none"><li>Developed the concept of an Autonomous Bike, with the aim to reduce accidents &amp; achieve better control on uneven terrain</li><li>Built simulation model &amp; small scaled prototype withstanding <b>upto +/- 13 degree</b> disturbance using Gyroscope &amp; PID controller</li><li>Backed by a renowned Indian electric vehicle manufacturer to develop full-fledged self-balancing electric bike's model</li></ul>	
<b>Centre for Robotics &amp; Intelligent Systems, India - Research Assistant</b>	Jan 2018 - May 2018
<ul style="list-style-type: none"><li>Developed mobile manipulation-based path-planner using weighted A* algorithm, enabling autonomous multi-object clean-up ops</li><li>Incorporated vision-based navigation approaches to identify obstacles &amp; classify them based on type, position &amp; spatial measurements</li></ul>	

## CONFERENCES

• <b>Nandanwar, K.</b> Akhavian, R. "Optimizing Construction Site Surveys: BIM-Based Scan Planning for Autonomous Indoor Scanning." <i>International Symposium on Automation and Robotics in Construction(ISARC)</i> by <i>The International Association for Automation and Robotics in Construction(IAARC)</i> . June 2024 (Submitted-in review)	
• <b>Nandanwar, K.</b> et. al. "Design & Modeling of Spanwise Adaptive Wings for a Reconfigurable VTOL." <i>11th National Conf. &amp; Exhibition on Aerospace &amp; Defence Related Mechanisms</i> by <i>APJ Abdul Kalam Missile Complex, ISRO &amp; INSARM</i> . Nov 2018	

CONFERENCE PROCEEDINGS

- **Nandanwar, K.** Rout, B.K. "Design and Trajectory Optimization of Delta Robot." *Advances in Industrial Machines and Mechanisms*, Springer. 2021. ISSN: 2195-4356
- Jain, A. Bhaskar, S. **Nandanwar, K.** Bansal, H.O. "Self-Balancing of Bike Using Gyroscope and Data Driven PID Controller." *Advances in Intelligent Systems & Computing (AISC)*, Springer. 2020. ISSN: 2194-5357. v989: 807-817
- **Nandanwar, K.** Rathore, D. Gupta, R. "A Novel DIY Machine Design to obtain Secondary Raw Materials from Absorbent Hygiene Waste." *Waste management as economic industry towards circular economy*, Springer. 2020. ISBN(P)-978-981-15-1619-1: 115-127

KEY PROJECTS

- 3D Object Detection: Camera-Lidar-GPS Sensor Fusion**Camera, Lidar, GPS
  - Implemented a lidar-camera-GPS sensor fusion to perform a 3D object detection on the KITTI dataset using hybrid fusion approach
- Multitask Learning: Joint Semantic, Depth, & Normal Estimation | [GitHub Link](#)**PyTorch, CNN - VGG16, ResNet
  - Developed unified encoder-decoder architecture using PyTorch to perform depth & surface estimation with semantic segmentation
  - Performed experiments using VGG16 & ResNet versions as encoders with ResNet offering better performance, but longer runtime
- Implementation of Generative Adversarial Networks (GANs) based research papers | [GitHub Link](#)**PyTorch
  - Implemented research papers related to GANs: DCGAN, Pix2Pix, Conditional GANs & CycleGAN
- 3D Reconstruction of a Scene Using Structure From Motion (SfM) | [GitHub Link](#)**Python, OpenCV
  - Deployed RANSAC to accurately match features, calculated essential matrix from fundamental matrix & estimated camera pose
  - Verified chirality condition using Non-Linear Triangulation, implemented PnP & Bundle Adjustment to improve accuracy of 3D model
- Visual Odometry for Localization in Autonomous Driving | [GitHub Link](#)**OpenCV, Python
  - Extracted features from images using vehicle’s camera setup to find matches, implemented match filtering by thresholding distance
  - Estimated the camera motion between subsequent photographs using PnP & Essential Matrix Decomposition to build trajectory
- Zhang Camera Calibration | [GitHub Link](#)**Python, OpenCV
  - Rebuilt Zhang Camera Calibration Method to implement 8-parameter camera calibration, achieving mean re-projection error of 0.5 px
  - Combined Eigen Decomposition & MLE to solve homogenous systems of linear equations for optimization of calibration parameter
- 3D Reconstruction of a scene using NeRF | [GitHub Link](#)**PyTorch
  - Reconstructed a 3D scene from a set of images with different viewpoints using NeRF
- Vehicle Detection using classical CV and DL approaches | [Presentation Link](#)**DeepSort, RNN, CNN, OpenCV
  - Performed HOG feature extraction on labeled training image set, trained Linear SVM classifier & implemented sliding-window tech
  - Created heatmap to follow detected vehicles and estimated bounding box on detected vehicles; compared results with YOLOv3
- Integration of Lip Movement Recognition & Sign Language**LipNet, Inception-V4, Python
  - Implemented LipNet & Inception v4 to read the movement of lips for controlled utterances, achieving around 98% precision
  - Integrated AI-driven ASL gesture recognition & Lip recognition to further enhance lip movement recognition, reaching 74% accuracy
- Autonomous Valet Parking Planning**Python
  - Developed kinematic planning using nonholonomic constraints for di-wheeled robot, car & truck with trailer for autonomous parking
  - Created graphical outputs of path by implementing built-in python functions resulting in instantaneous plotting of the path forecasts
- Deep Reinforcement Learning for Value Function Estimation**DQN
  - Experimented versions of Deep Q Learning (Double DQN, Dueling DQN) for Atari Breakout game from Open Gym AI

RELEVANT SKILLS & COURSES

• <b>Languages:</b>	Python, C/C++, MATLAB, Bash, HTML/CSS
• <b>Frameworks &amp; Tools:</b>	PyTorch, ROS (Noetic, Foxy), Gazebo, Git, Docker, OpenCV
• <b>Libraries:</b>	PyTorch, Numpy, Pandas, Matplotlib, Scikit-learn
• <b>Courses:</b>	Artificial Intelligence, Computer Vision, Deep Learning, Motion Planning, Machine Learning Reinforcement Learning, Robot Control, Sensor Fusion

TECHNICAL INITIATIVES

- PluckTech**
  - Integrated a robust manipulator with a soft robotic gripper for handling delicate crops and autonomous harvesting
  - Combined computer vision, motion planning, and soft robotics to withstand the challenges of outdoor agricultural environments
- Team Garuda | [Team Website](#)**
  - Designed the Fuselage, Empennage & Landing gears for a reconfigurable VTOL Aircraft *Druta* for expanded mission capabilities
  - Structured a novel expansion-retraction mechanism of Variable Diameter Coaxial Tiltrotor & Spanwise Adaptive Wings
  - Performed detailed analysis to check airframe loads, validated design using ANSYS & self-developed MATLAB codes iterations

TEACHING EXPERIENCE

ECE 2311: CONTINUOUS TIME SIGNAL & SYSTEM ANALYSIS	ECE 2312: DISCRETE TIME SIGNAL & SYSTEM ANALYSIS
ECE 2010: INTRO TO ELECTRICAL & COMPUTER ENG	MATH 1022: CALCULUS II
MME 532: DIFFERENTIAL EQUATIONS	MME 527: LINEAR MODELS II

ACHIEVEMENTS & AWARDS

- **Honorable mention** at AMD Robotics Innovation Challenge 2023 for innovation in the autonomous agricultural produce harvest
- **Best Undergrad Entry** in 35<sup>th</sup> International Aerospace Design Competition organised by *American Helicopter Society & US Army*
- **Second Runner-up** in maiden edition of Schaeffler India ‘Open Inspiration’ among 110+ entries for designing self-balancing bike