# Kunal Nandanwar

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## Education

**Worcester Polytechnic Institute - USA** *MS Robotics*

**Birla Institute of Technology & Science, Pilani - India** *Bachelor in Engineering(Hons.)*

## Patent

- **Nandanwar, K**. Javed, H. Jamali, N. 2023. *SYSTEM & METHOD FOR COMPLETING THREE DIMENSIONAL FACE RECONSTRUCTION*

## Relevant Skills

- **Programming Languages**: Python, C, C++, MATLAB
- **Tools**: PyTorch, ROS (Noetic, Foxy), Gazebo, Git, Docker, OpenCV

## Work Experience

**FieldAI -** ***Autonomy*** *Jul 2023 - Present*

- Implemented optimal scan positioning for an automated scanning process with an autonomous robot platform

**Vecros Aerial Robotics -** ***Computer Vision Intern*** *Jan 2023 - May 2023*

- Incorporating 2-phased novel techniques for autonomous image capture for improved accuracy & efficiency of reconstruction process

**Honda Research Institute, San José -** ***Machine Learning Intern*** *Sept 2022 - Jan 2023*

- Analyzed human behavioural data and estimated human satisfaction level in human-robot interaction using transfer learning

**Brain Corporation, San Diego -** ***Robotics Intern*** *May 2022 - Aug 2022*

- Worked with Robot Autonomy Team to classify items in the warehouse for smart-robot pick-up & delivery

**John Deere, India -** ***Engineer II*** *Jul 2019 - Jul 2021*

- Contributed in design for vision-based automated rear & front implement-attachments for autonomous sprayers & tractors
- Created a CREO program using C++ to create 32 rear-wheel configurations, reducing design time by around **20x**
- Developed ML-based computer vision model for traffic signal detection with 92% precision & for weed detection with 88% precision

**Eversource Energy & WPI -** ***NSF Graduate Research Fellow*** **|** ***Video Demo Link*** *Jan 2023 - May 2023*

- Responsible to design an autonomous robot that can patrol cables for deterring birds from congregating near utility assets
- Deployed custom trained deep learning model on Jetson Nano powered robot; integrated camera & Time of Flight sensors using ROS

## Key Projects

**Multitask Learning: Joint Semantic, Depth, & Normal Estimation |** ***GitHub Link*** *PyTorch, 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

**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

**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, YOLO, 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 detetcted vehicles; compared results with YOLOv3

**Sports Celebrity Image Classification |** ***GitHub Link*** *SVM, Logistic Regression, Random Forest*

- Built model using SVM, logistic regression & random forest, used wavelet transforms for Feature Eng, fine-tuned using gridsearchcv

## Innovation Disclosure, Publications & Conferences

- **[ID.] Nandanwar, K**. 2021. *Vision-Based Automated Implement-Attachment.* Submitted Jan 10, 2021. (Under review-John Deere IP)
- **[Publication] Nandanwar, K.** Rout, B.K. "Design and Trajectory Optimization of Delta Robot." *Advances in Industrial Machines and Mechanisms, Springer.* 2021. ISSN: 2195-4356
- **[Publication]** 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
- **[Conference] Nandanwar, K.** et. al. "Design & Modeling of Spanwise Adaptive Wings for a Reconfigurable VTOL." Paper at *11th National Conf. & Exhibition on Aerospace & Defence Related Mechanisms* by *APJ Abdul Kalam Missile Complex, ISRO & INSARM*. Nov 2018

## Achievements & Awards

- **The Higher Education Emergency Relief Fund III (HEERF III): Student Grant 2021** recipient from *U.S. Department of Education*
- **Best Undergrad Entry 2018** in $35^{th}$ International Aerospace Design Competition organised by *American Helicopter Society & US Army*
- **BITS Pilani Merit-Cum-Need(MCN) Scholarship** awardee in all semesters of the undergraduate program