

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:** ROS (Noetic, Foxy), Gazebo, Git, Docker, OpenCV
- **Framework/Packages:** Numpy, Pandas, Matplotlib, Scikit-learn, PyTorch

WORK EXPERIENCE

John Deere, India - Engineer II

Jul 2019 - Jul 2021

- Contributed in design for vision-based automated rear & front implement-attachments for autonomous sprayers & tractors
- Automated design process for 32 rear-wheel-configurations by creating PTC CREO program using C++, reducing design time by 20x

Vecros Aerial Robotics - Computer Vision

Jan 2023 - May 2023

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

Eversource Energy & Worcester Polytechnic Institute - NSF Graduate Research Fellow

Jan 2023 - May 2023

- Worked with Eversource Energy on autonomous robot that can patrol cables for deterring birds from congregating near utility assets
- Deployed custom trained YOLO model on Jetson Nano powered robot; integrated camera & Time of Flight sensors using ROS Noetic

Honda Research Institute, San José - Research 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

Centre for Robotics & Intelligent Systems, India - Research Assistant

Jan 2018 - May 2018

- Developed mobile manipulation-based path-planner using weighted A* algorithm, enabling autonomous multi-object clean-up ops
- Incorporated vision-based navigation approaches to identify obstacles & classify them based on type, position & spatial measurements

KEY PROJECTS

Implementation of Generative Adversarial Networks (GANs) based research papers

PyTorch

- Implemented research papers related to GANs: DCGAN, Pix2Pix, Conditional GANs & CycleGAN

3D Reconstruction of a Scene Using Structure From Motion (SfM)

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

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

MultiNet-2: Joint Semantic, Depth, & Normal Estimation

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

Zhang Camera Calibration

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

Object-Segmentation-for-Manipulation

PyTorch

- Developed code to read a depth image with defined camera parameters, deproject it into a point cloud and filter objects on a table

3D Reconstruction of a scene using NeRF

PyTorch

- Reconstructed a 3D scene from a set of images with different viewpoints using NeRF

Vehicle Detection using classical CV and DL approaches

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 detected vehicles; compared results with YOLOv3

Sports Celebrity Image Classification

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 35th 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