Kunal Nandanwar

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+1-(508)-410-0057 kgnandanwar@wpi.edu linkedin.com/in/kgnandanwar https://github.com/kgnandanwar Portfolio

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 Intern*** *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

Manipulation & Environmental Robotics Labs, WPI - Research Assistant | ***Presentation Link*** *Jan 2022 - May 2022*

- Developed 3D motion planner using A* algorithm for different motion primitives considering their cost of traversal
- Designed a parallel variable friction gripper model for improved object manipulation with precision control along object-surface

BITS Pilani, India - Research Assistant | ***Presentation Link*** *Aug 2018 - Dec 2018*

- Developed the concept of an Autonomous Bike, with the aim to reduce accidents & achieve better control on uneven terrain
- Built simulation model & small scaled prototype withstanding **upto +/- 13 degree** disturbance using Gyroscope & PID controller
- Backed by a renowned Indian electric vehicle manufacturer to develop full-fledged self-balancing electric bike's model

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

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

Perception Using Optical Flow | *GitHub Link* *PyTorch*
- Implemented optical flow to determine the relative speed of cars in a video.

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

Image Stitching | *GitHub Link* *Python*
- Estimated homography between image pairs using feature correspondences for image stitching
- Used adaptive non-maximal suppression for uniform features & RANSAC for removing the outliers among the feature matches

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

Object Segmentation for Manipulation | *GitHub Link* *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 | *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