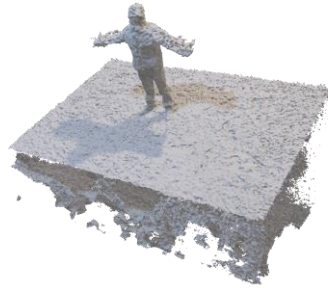# Instant-NGP-based Autonomous 3D Reconstruction Using Drone Imagery

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Project Motivation & Goal

Motivations:

- ## Automating Image Collection for Precision and Efficiency
  Autonomously capturing images ensures consistent and optimized data collection, reducing human effort and improving the quality of 3D reconstructions.

- ## Expanding 3D Reconstruction to Challenging Environments
  Drones enable imaging in hard-to-reach aerial views or unsafe locations, opening possibilities for applications in disaster zones, dense forests, or mapping and planning from aerial view.

- ## Facilitating Optimal Viewpoint Selection
  Developing autonomous algorithms to identify the best angles for imaging ensures higher reconstruction fidelity and contributes to advancements in path planning and adaptive imaging.

Goal: Achieve a 3D reconstruction of a target object using Instant-NGP (a Neural Radiance Field-based model) with images captured autonomously by a drone.

Approach & Solution
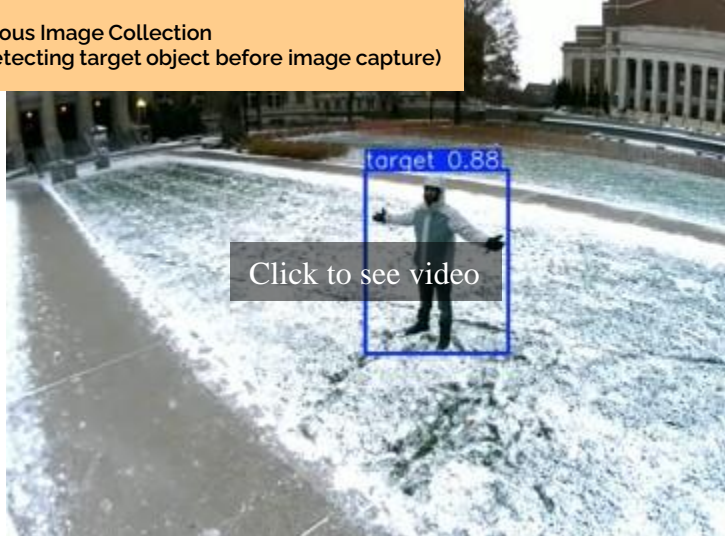
Autonomous Image Collection

- Train a detection model (Yolov8) to localize target in the camera frame.

- Drone detects target object using the trained detection model in real time.

- Drone moves to an optimal position for image capture keeping the target object in the field of view.

- Drone autonomously circles around the target object to capture view of the target from different angles.

3D Reconstruction using Instant-NGP

- Sort non-blurry images from the captured set and randomly choose 300 images for reconstruction.

- Run COLMAP to estimate extrinsic and intrinsic camera parameters of each of the captured images using Structure-from-Motion pipeline.

- Use captured images and camera trajectory to train a Instant-NGP model.

- Optimized the encoding parameters like 'n_levels' and 'log2_hashmap_size' and the number of layers and neurons of the underlying fully fused MLP of Instant-NGP to have high fidelity 3D reconstruction of the target.

- Remove background to focus on the target object.

Autonomous Image Collection
(drone detecting target object before image capture)

target 0.88

Click to see video
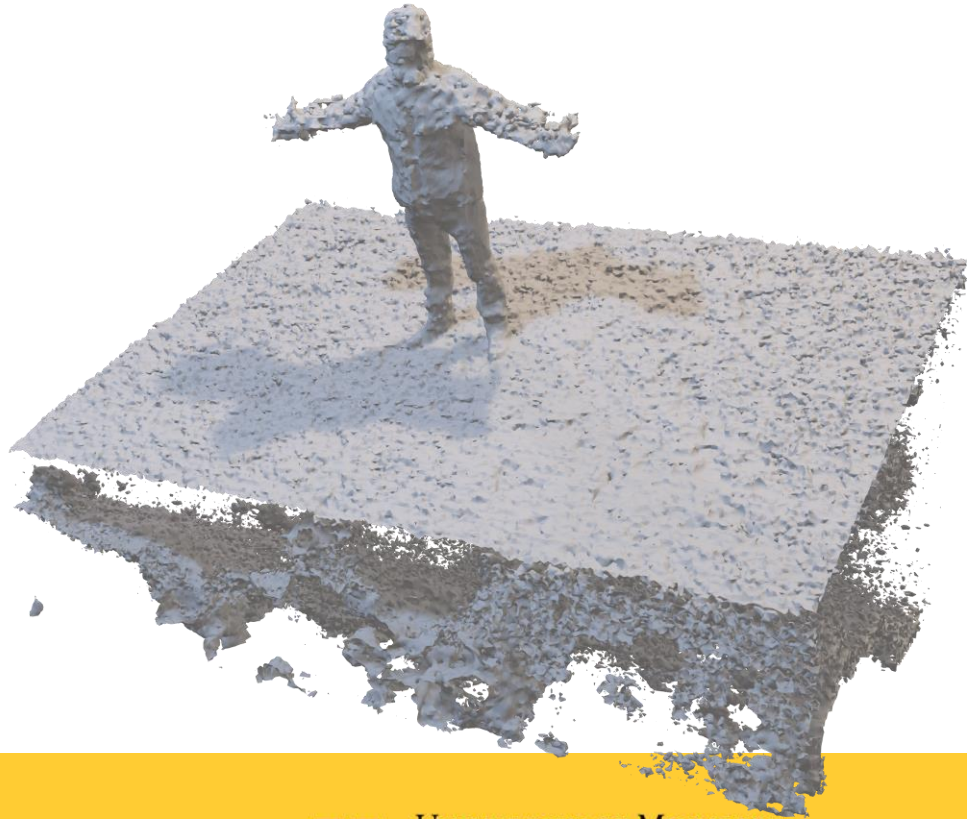
3D Reconstruction using Instant-NGP

Click to see video

Autonomous Image Collection
(drone circling around target object)

Click to see video

3D Reconstruction using Instant-NGP

Click to see video

QnA