

DroneMOM

Drone Model Output Machine

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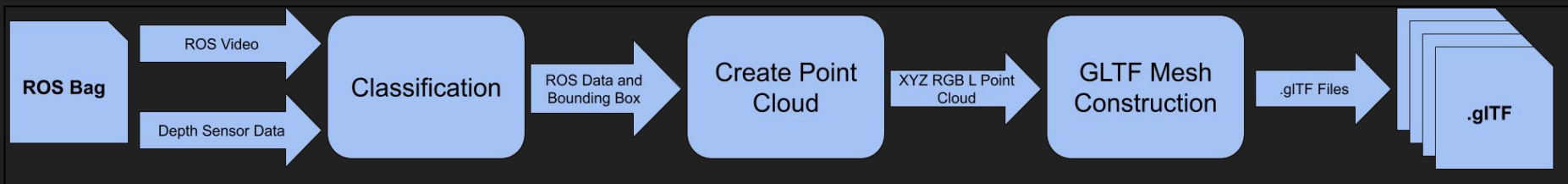
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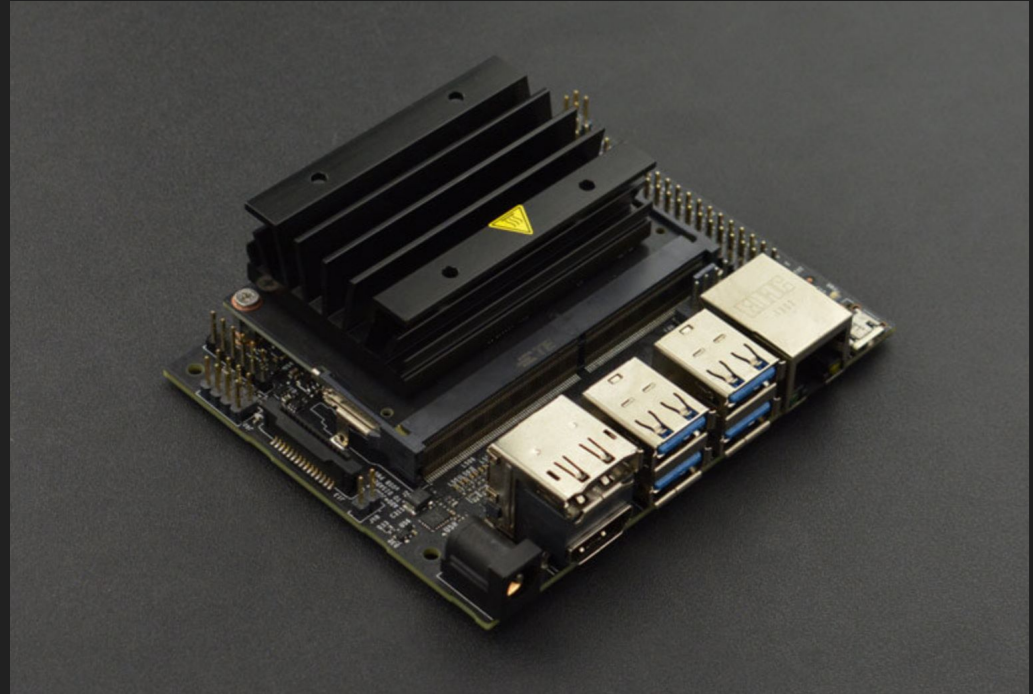
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System Design



Jetson Nano

- System On Chip with Nvidia GPU
- Limited RAM + Storage
- Limited Processing Capabilities
- Used for Aerial Platforms
- Robot Operating System (ROS) provides system infrastructure



Classification

- Utilized Mobilenet as architecture
- Accelerated classification with TensorRT
- Implemented cuda algorithms with shared memory
- Bounding Boxes show what is classified in the frame
- ~50ms per inference
- Used ROS to implement a complex system



What is TensorRT?

- Think of it like DXR
- Build a tensorRT engine (like CPU side of DXR)
- Run inference on GPU based on this accelerated engine.

TensorRT Optimizations and Performance



Weight & Activation Precision Calibration

Maximizes throughput by quantizing models to INT8 while preserving accuracy



Layer & Tensor Fusion

Optimizes use of GPU memory and bandwidth by fusing nodes in a kernel



Kernel Auto-Tuning

Selects best data layers and algorithms based on target GPU platform



Dynamic Tensor Memory

Minimizes memory footprint and re-uses memory for tensors efficiently

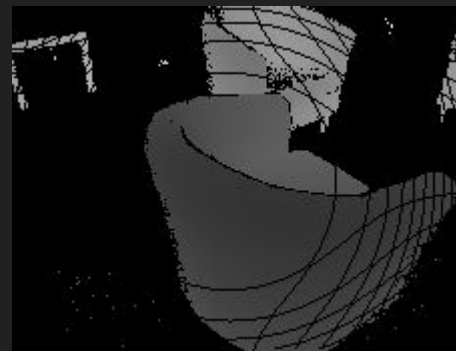


Multi-Stream Execution

Scalable design to process multiple input streams in parallel

Point Cloud Generation

- Input: color image, depth image

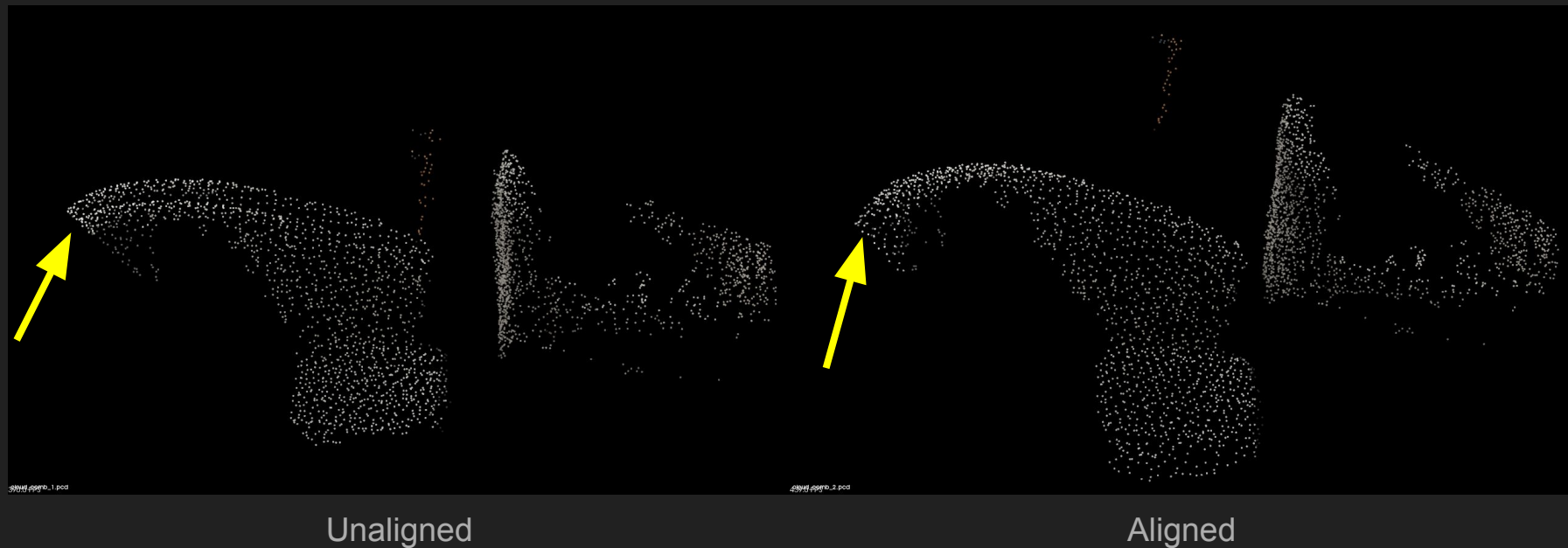


Point Cloud Generation

- Align depth and color images, project into 3d space

Point Cloud Generation

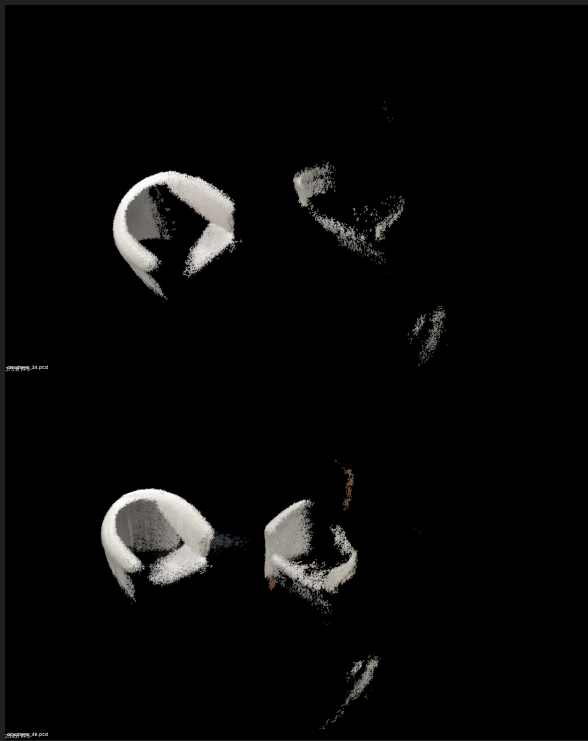
- Align and register frames for subsequent point clouds



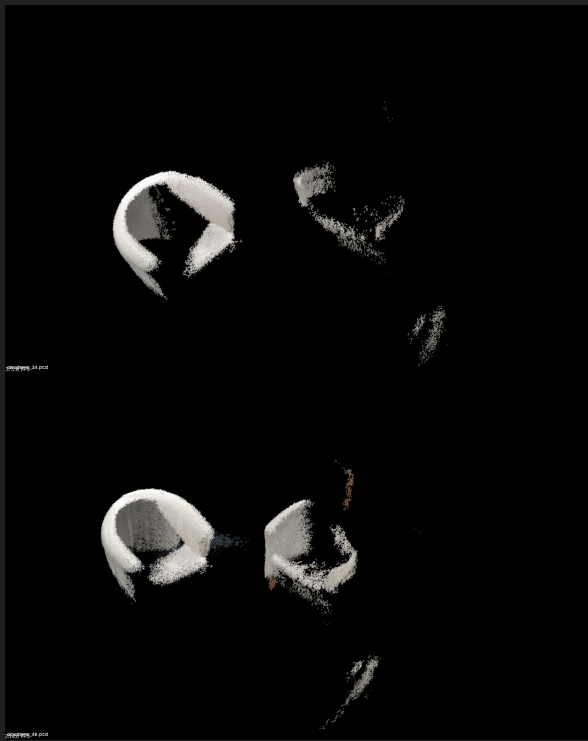
Point Cloud Generation

- Accumulate subsequent frames to create overall point cloud

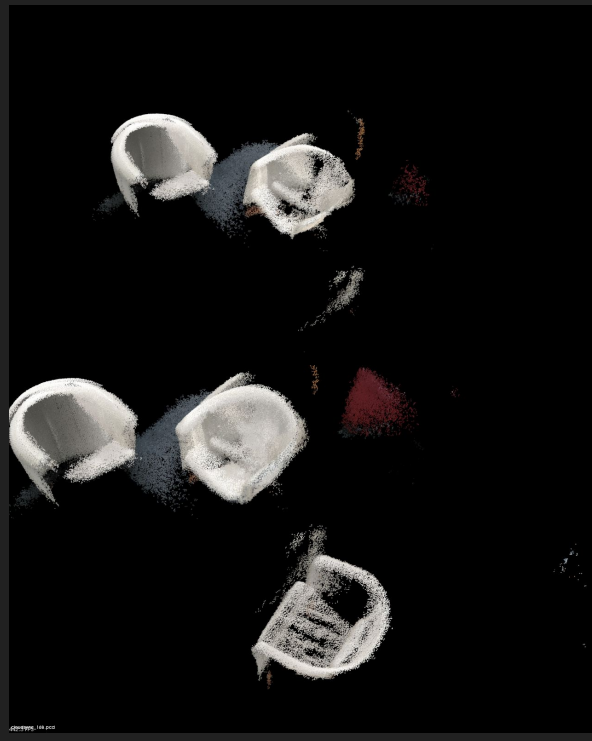
24 Frames



48 Frames



120 Frames

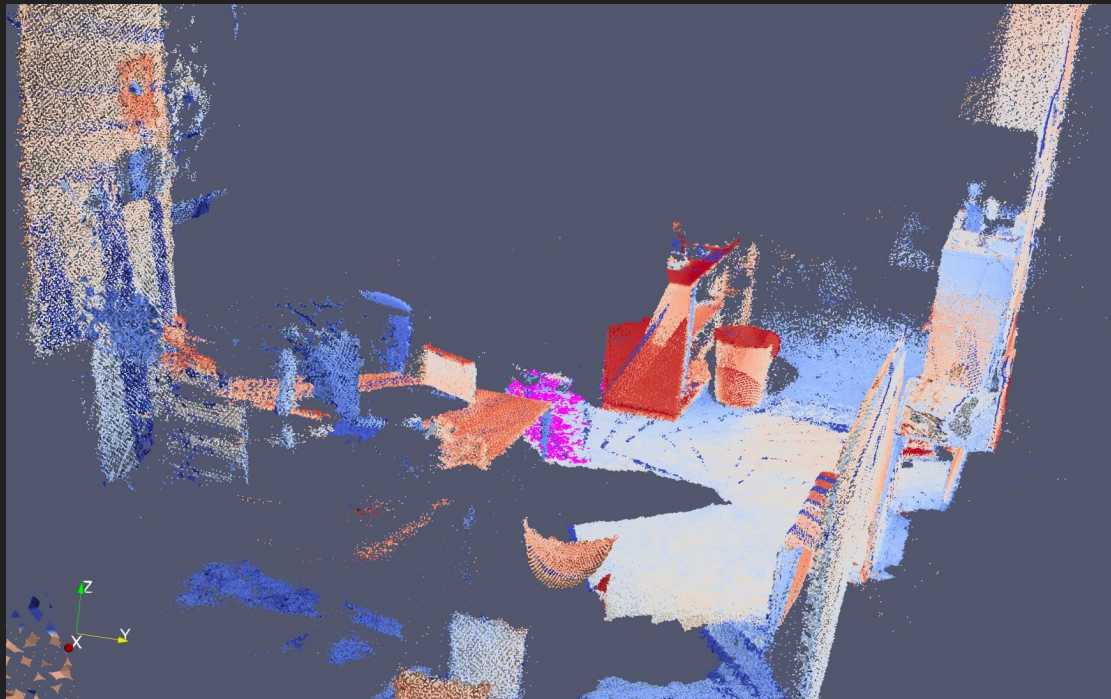


168 Frames



GLTF Mesh Construction

- Convert a Point Cloud into a GLTF Mesh
- Challenges
 - Noise in the Point Cloud
 - Too many points
 - Incomplete data



GLTF Mesh Construction

1. Downsample using a Uniform Voxel grid
2. Remove Statistical Outliers
3. Smoothing through Moving Least Squares
4. Point Normal Estimation
5. Greedy Triangulation Mesh Construction



Mesh using a small frame count

Output Mesh after 5GB of data

Not quite right...

- Coordinate system not preserved
- GLTF Vertex Winding Order



Special Thanks + Credits

Dewang + Vaibhav (Shadow Team Point cloud and ML help)

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Andrew Feng

DroneMOM



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Me waiting for `make` to finish on the Jetson