



Project Plan Presentation

LiDAR and Stereo Image Fusion for Autonomous Navigation

The Capstone Experience

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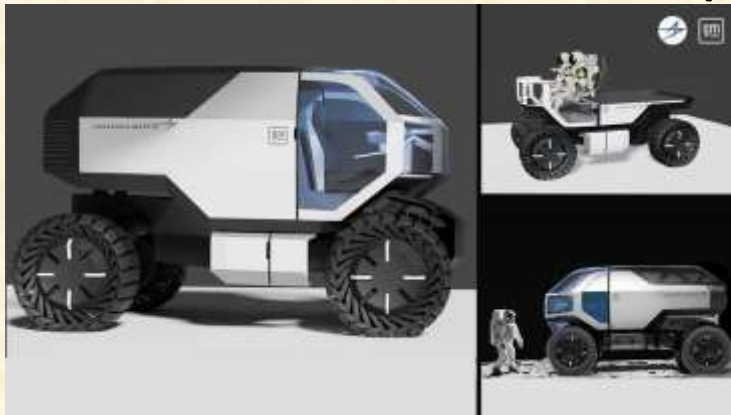
Fall 2022



*From Students...
...to Professionals*

Project Sponsor Overview

- Lockheed Martin is a Fortune 500 company employing over 100,000 people at over 60 locations
- Vast departments in Space, Aeronautics, Missile and Fire Control, and Rotary and Mission Systems
- Lockheed Martin Space advances vital technologies for future and current space endeavors

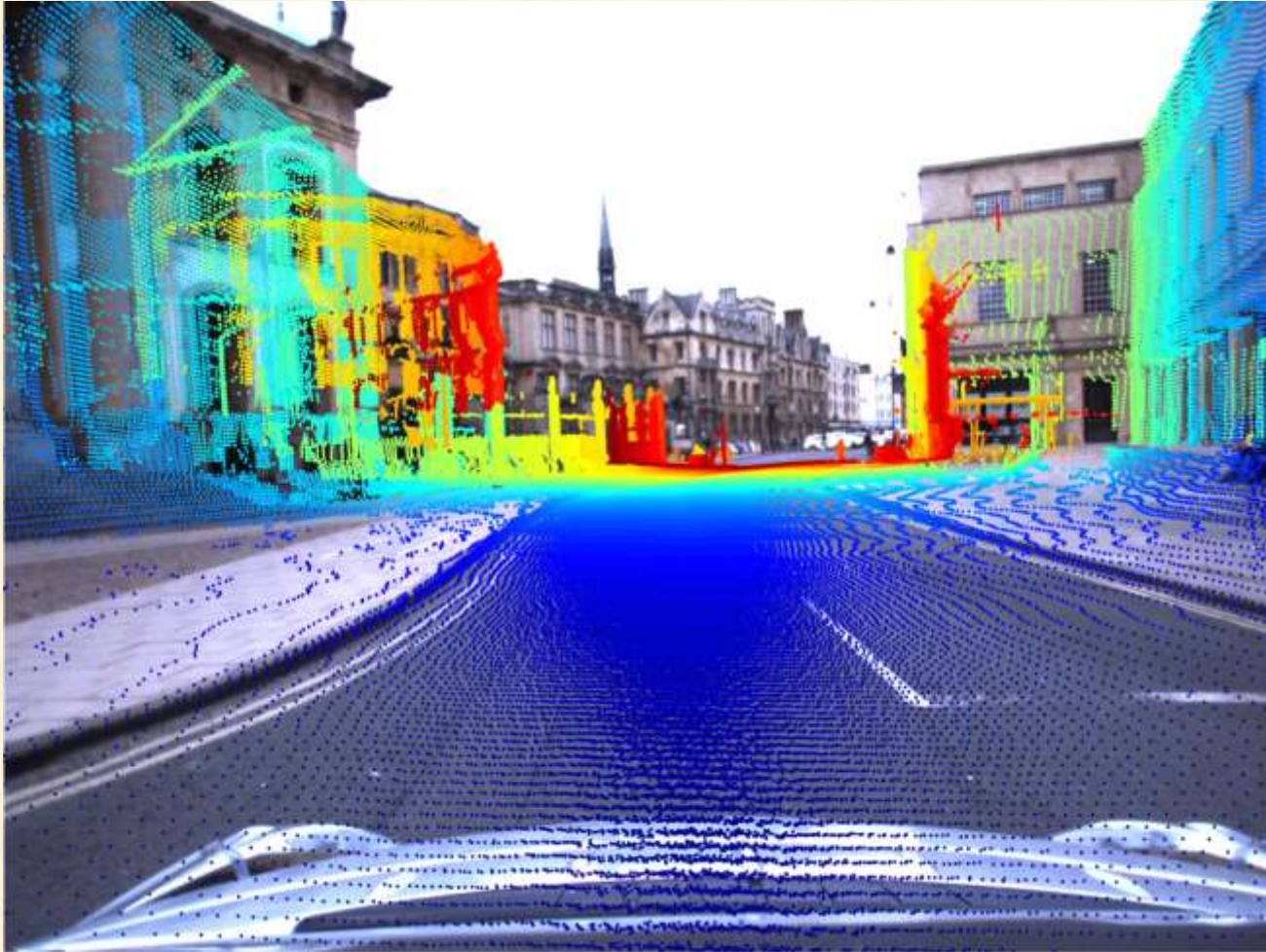


Project Functional Specifications

- Sense and communicate information about the surrounding lunar environment
- Facilitate messaging between IoT devices on the lunar surface
- Fuse together pointclouds and stereo-image data for accurate depth estimation and object detection on an embedded system



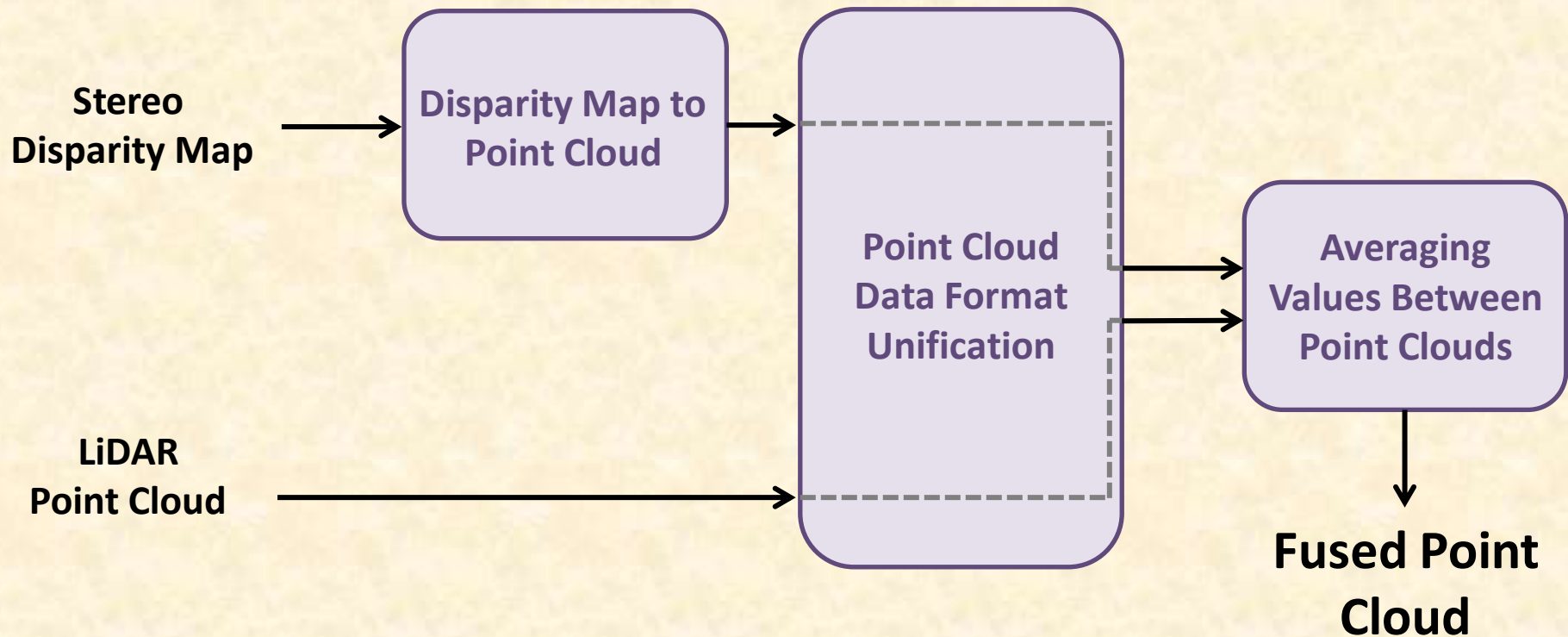
Screen Mockup: Pointclouds



Screen Mockup: Stereo-Disparity Mapping



Screen Mockup: Fusion Flowchart



Screen Mockup: 3D YOLO Bounding Boxes



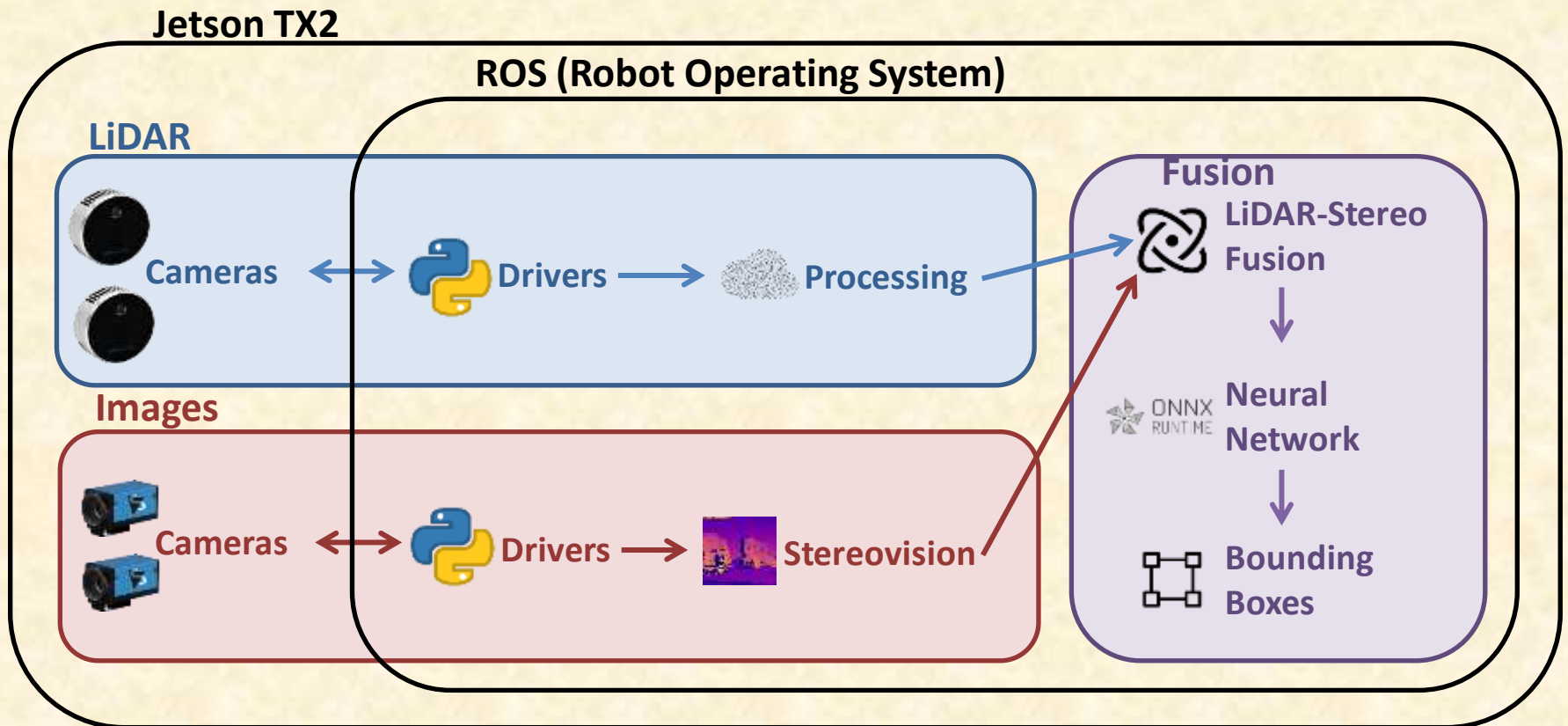
Project Technical Specifications

- Fuse pointclouds and stereovision data into a singular combined format
- Train 3D YOLO and Pointnet neural networks to process the data
 - Models will be hot swappable
- Train PointDAN neural network to allow for domain-agnostic detections
- Create a ROS wrapper using Python/C++ to drive realtime sensors in testing the above networks
- Add messaging between system and IoT devices using MQTT and SmartSat™



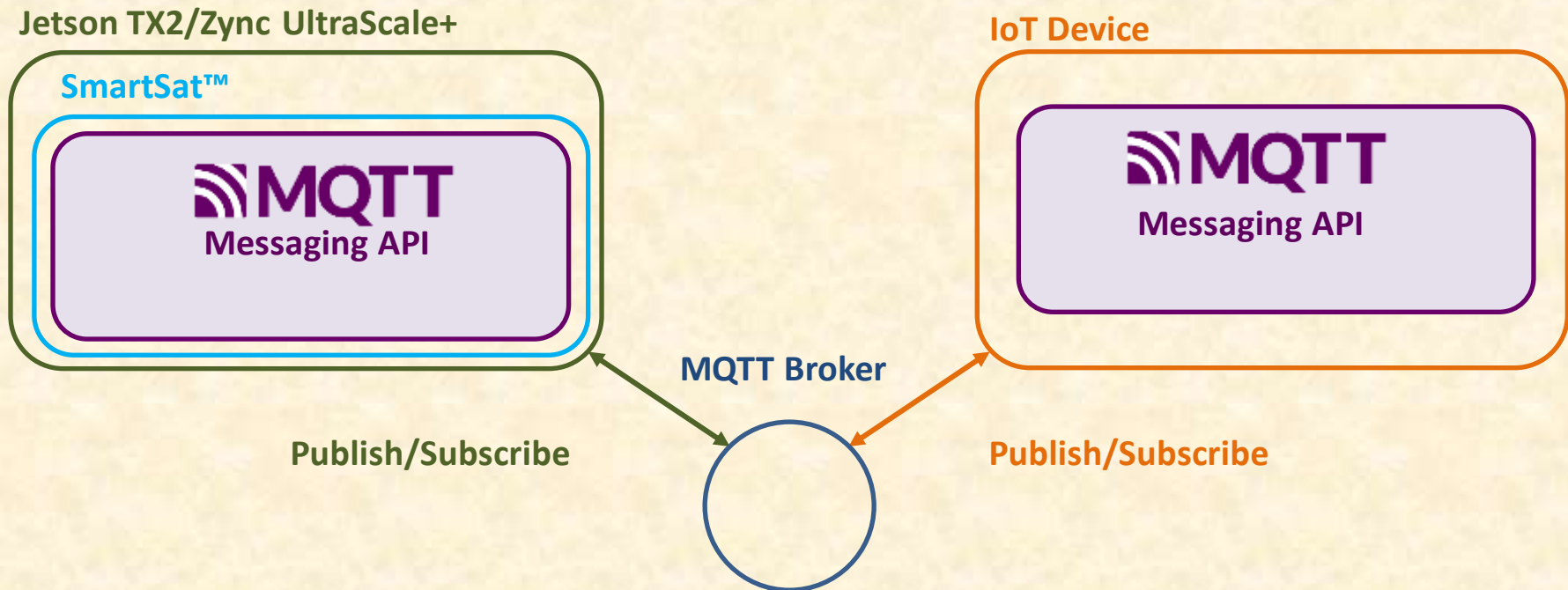
Project System Architecture

Fusion



Project System Architecture

MQTT Plugin



Project System Components

- Hardware Platforms
 - NVIDIA Jetson TX2 Developer Kit
 - Xilinx Zync Ultrascale+
 - Intel Realsense LiDAR Camera
 - ImagingSource DMK 33GP031
- Software Platforms / Technologies
 - ROS (Robot Operating System)
 - Python
 - NVIDIA Jetpack
 - Kitti dataset
 - MQTT
 - VxWorks
 - ONNX runtime



Project Risks

- Switching from prerecorded Lidar Data to sensor data
 - Initially the team will have to use Kitti data for the models while the ROS wrapper is developed.
 - ROS provides tools allowing sensor data to be easily read and integrated. The Kitti data format will be the same as the sensor allowing quick integration.
- Developing a system that fuses LiDAR and stereo data
 - LiDAR and stereo data are typically different formats, respectively a pointcloud and a disparity map.
 - The team will be converting the stereo disparity map into a pointcloud and combining them into a fused pointcloud
- Creating the neural network to process fused pointclouds
 - Most neural networks for 3D image processing currently use either LiDAR or stereo data. The team must implement a model that is trained on the fused data from both.
 - Since the team will be using fused pointclouds, a model trained on LiDAR pointclouds will work with the fused data.
- The model architecture must be size-efficient and be high performance
 - The model will be deployed on an embedded system with memory and compute constraints
 - The team will be benchmarking and testing the pretrained model to ensure performance, as well as utilizing integer quantization
- MQTT plugin must be compatible with multiple platforms
 - The plugin is required to run on multiple different systems with different backends
 - The team will test multiple MQTT APIs on all platforms to ensure that there is a suitable candidate



Questions?

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