Alpha Presentation
LiDAR and Stereo Image Fusion for Autonomous Navigation
The Capstone Experience
Team Lockheed Martin Space

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Project Overview

• Fuse LiDAR point clouds and stereo-imagery to generate a dense point cloud

• Utilization of multiple neural networks to detect on a dense point cloud

• Creation of a ROS wrapper to run the above systems on the Jetson TX2, with physical LiDAR and stereo camera components

• Setup MQTT Messaging to communicate between IoT devices
System Architecture

Jetson TX2

ROS (Robot Operating System)

LiDAR

- Cameras
- Drivers
- Processing

Images

- Cameras
- Drivers
- Stereovision

Fusion

- LiDAR-Stereo Fusion
- Neural Network
- Bounding Boxes
Jetson TX2, LiDAR, Mono Cameras
Stereo → Disparity Map → Point Cloud
YOLO3D Detections
MQTT Messaging

```
2022-10-11T01:46:38.3747812 INFO [HelloWorld] SendAndReceiveMessages: Received message: "Hello from CSE498 Team Lockheed Martin!"
2022-10-11T01:46:38.3781872 NOTICE [HelloWorld] SendAndReceiveMessages: Cycle 0 completed
2022-10-11T01:46:38.3786122 INFO [HelloWorld] SendAndReceiveMessages: Sent message: "Hello from CSE498 Team Lockheed Martin!"
2022-10-11T01:46:38.3790267 INFO [HelloWorld] SendAndReceiveMessages: Received message: "Hello from CSE498 Team Lockheed Martin!"
2022-10-11T01:46:38.37922472 NOTICE [HelloWorld] SendAndReceiveMessages: Cycle 1 completed
2022-10-11T01:46:38.3794472 INFO [HelloWorld] SendAndReceiveMessages: Sent message: "Hello from CSE498 Team Lockheed Martin!"
2022-10-11T01:46:38.3796562 INFO [HelloWorld] SendAndReceiveMessages: Received message: "Hello from CSE498 Team Lockheed Martin!"
2022-10-11T01:46:38.3798152 NOTICE [HelloWorld] SendAndReceiveMessages: Cycle 2 completed
2022-10-11T01:46:38.3806712 INFO [HelloWorld] SendAndReceiveMessages: Sent message: "Hello from CSE498 Team Lockheed Martin!"
2022-10-11T01:46:38.3822937 INFO [HelloWorld] SendAndReceiveMessages: Received message: "Hello from CSE498 Team Lockheed Martin!"
2022-10-11T01:46:38.3825892 NOTICE [HelloWorld] SendAndReceiveMessages: Cycle 3 completed
2022-10-11T01:46:38.3868902 INFO [HelloWorld] SendAndReceiveMessages: Sent message: "Hello from CSE498 Team Lockheed Martin!"
2022-10-11T01:46:38.3871312 INFO [HelloWorld] SendAndReceiveMessages: Received message: "Hello from CSE498 Team Lockheed Martin!"
2022-10-11T01:46:38.3871792 NOTICE [HelloWorld] SendAndReceiveMessages: Cycle 4 completed
2022-10-11T01:46:38.3942232 INFO [HelloWorld] SendAndReceiveMessages: Sent message: "Hello from CSE498 Team Lockheed Martin!"
2022-10-11T01:46:38.3944372 INFO [HelloWorld] SendAndReceiveMessages: Received message: "Hello from CSE498 Team Lockheed Martin!"
2022-10-11T01:46:38.3944882 NOTICE [HelloWorld] SendAndReceiveMessages: Cycle 5 completed
2022-10-11T01:46:38.3945612 INFO [HelloWorld] SendAndReceiveMessages: Sent message: "Hello from CSE498 Team Lockheed Martin!"
2022-10-11T01:46:38.3946492 INFO [HelloWorld] SendAndReceiveMessages: Received message: "Hello from CSE498 Team Lockheed Martin!"
2022-10-11T01:46:38.3946892 NOTICE [HelloWorld] SendAndReceiveMessages: Cycle 6 completed
2022-10-11T01:46:38.3947502 INFO [HelloWorld] SendAndReceiveMessages: Sent message: "Hello from CSE498 Team Lockheed Martin!"
2022-10-11T01:46:38.3948282 INFO [HelloWorld] SendAndReceiveMessages: Received message: "Hello from CSE498 Team Lockheed Martin!"
2022-10-11T01:46:38.3948592 NOTICE [HelloWorld] SendAndReceiveMessages: Cycle 7 completed
2022-10-11T01:46:38.3952527 INFO [HelloWorld] SendAndReceiveMessages: Sent message: "Hello from CSE498 Team Lockheed Martin!"
2022-10-11T01:46:38.3956442 INFO [HelloWorld] SendAndReceiveMessages: Received message: "Hello from CSE498 Team Lockheed Martin!"
2022-10-11T01:46:38.3956882 NOTICE [HelloWorld] SendAndReceiveMessages: Cycle 8 completed
2022-10-11T01:46:38.3960642 INFO [HelloWorld] SendAndReceiveMessages: Sent message: "Hello from CSE498 Team Lockheed Martin!"
2022-10-11T01:46:38.3965582 INFO [HelloWorld] SendAndReceiveMessages: Received message: "Hello from CSE498 Team Lockheed Martin!"
2022-10-11T01:46:38.3966362 NOTICE [HelloWorld] SendAndReceiveMessages: Cycle 9 completed
2022-10-11T01:46:38.4073972 NOTICE [HelloWorld] LifecycleClient: Reporting exit status DEACTIVATED
2022-10-11T01:46:38.4087292 INFO [HelloWorld] ************************************************ LOG END ************************************************
dittmann@ubuntu:~/Documents/code_repo/smartsat_hello_world/HelloWorld$  
```
What’s left to do?

- Neural Networks
  - Train on fused-data
  - ONNX conversion testing
  - Optimize for TensorRT
  - Deploy on Jetson
- Fusion
  - Point cloud concatenation
- ROS Wrapper and Jetson
  - Hardware sync for LiDAR
  - Logging system overhaul
  - System sanity checks
  - Inference integration
- MQTT
  - Integrate MQTT with SmartSat™ SDK
  - Port code to VxWorks and embedded boards
  - Develop unit tests with Google Test
Questions?