Boston University
Electrical & Computer Engineering
EC464: Final Test Plan
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Required Materials:

Hardware:

- Aerial LiDAR System:
  - DJI Inspire 1 Pro (drone)
  - SICK multiscan100 LiDAR
  - Jetson Orin Nano
- Embedded Nodes System:
  - SAMD21 Pro RF
  - RMF95W 915MHz Transceiver
  - BME688 Sensor
  - 128GB SD
  - I2C SD Card Breakout

Software:

- Shell script to process LiDAR data: processData.sh
  - FUSION/LDV library: GroundFilter, GridSurfaceCreate, CanopyModel, TreeSeg, DTM2XYZ, Cover
  - LAStools library: txt2las
  - density.bat script
- Python program: visualize2D.py
- ROS1 and Sick libraries installed with rviz on Linux device
- SOPAS ET software on windows device
- ROS package laser_assembler
- PDAL package

Setup:

The setup has three parts: LiDAR data acquisition, LiDAR data processing and visualization, and embedded nodes. For LiDAR data acquisition, the LiDAR and a Jetson Nano are mounted onto the drone using a 3d-printed mount. The LiDAR is connected to the Jetson Nano with Linux OS, ROS1, and SICK libraries. The drone can then be flown around trees with the LiDAR taking scans and the Jetson Nano saving the data into a ROSBAG file. Unfortunately, while we can collect data with this setup, we have not flown the drone due to safety concerns about the weight imbalance on the drone.

For the data processing and visualization, we have a scan taken from the LiDAR. The resulting ROSBAG file is subsequently converted to a single PCD file using laser_assembler and then to a LAS file using PDAL. To create the models, we require LiDAR data with trees, so this step is done with sample LiDAR data. The LAS file is inputted into the processData.sh script and produces multiple models: DTM, CHM, tree clusters, canopy cover, and vegetation density at various height stratas. The tree clusters, canopy covers, and vegetation densities can be better visualized as a 2D heat map.

For the embedded nodes we will be doing a live demonstration simulating how the nodes will interact when deployed. Due to the space limitations of the testing environment, we are not attaching antennas to prevent overloading the receiver and limit interference of local 900MHz networks. We will also not be able to achieve enough distance to exit transmission range, so to simulate entering a sensor node's field we will manually power on the sensor. The collector will constantly attempt to collect data via a broadcast message until the sensor wakes up. The sensor will receive the broadcast and dump the SD card data back to the collector which will then be written to the SD.

Pre-testing Setup Procedure:

LiDAR Data Acquisition:

1. Take a scan with just the LiDAR

2. Retrieve data as ROSBAG
3. Mount the LiDAR and Jetson Nano to drone to show the setup

LiDAR Data Processing:

1. Convert ROSBAG into a single PCD file and then to a LAS file
2. Run shell script on LAS file
3. Prepare images for the models

Embedded Nodes:

1. Power off Sensor Node (Simulating node out of range)
2. Power on Collector Node (Simulating node on the drone)
3. Connect Collector Node via serial to serial terminal

Testing Procedure:

LiDAR Data Acquisition:

- View video of drone flying
- Show setup of the drone

LiDAR Data Processing:

- Demonstrate the conversion of ROSBAG to PCD to LAS
- Show models of the acquired data

Embedded Nodes:

1. Power on sensor node (Simulating node in range)
2. View data being sent across wireless link
3. Remove SD from Collector Node
4. Open file on SD to confirm data collection.

Measurable Criteria:

LiDAR Data Acquisition:

- LiDAR and Jetson Nano is successfully mounted
- LiDAR can successfully take and store a scan.

LiDAR Data Processing:

- The LiDAR scan can be viewed in LAS format.
- The DTM should show the terrain of the region of interest.
- The CHM should show the vegetation heights of the region of interest.
- The 2D heat map of the tree segments should show where trees are clustered.
- The canopy cover model and the corresponding 2D heat map should indicate the percentages of canopy cover
- The vegetation density at 17 heights stratas shows the density of the vegetation.

Embedded Nodes:

- Displaying correct packet information in the terminal when sending
- Data correctly copied to the collector SD card after transmission