Transportation Infrastructure Perception Data Fusion and Detection Using AI Technology

THE WILLIAM STATES LEE COLLEGE OF ENGINEERING

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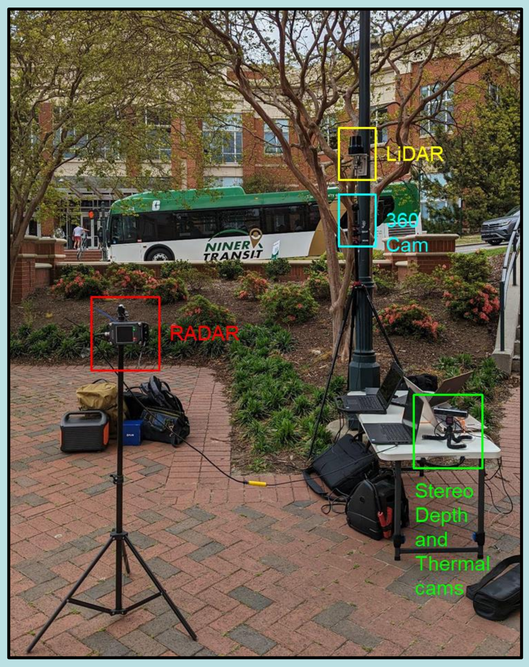
Project Objective

The project objective was to utilize a variety of sensors: LiDAR, RADAR, 360 camera, stereo depth camera, and thermal camera, for detecting and tracking mixed traffic objects (e.g., vehicles and pedestrians). This data was to be cleansed through machine learning algorithms and collected on a database for traffic safety analysis.

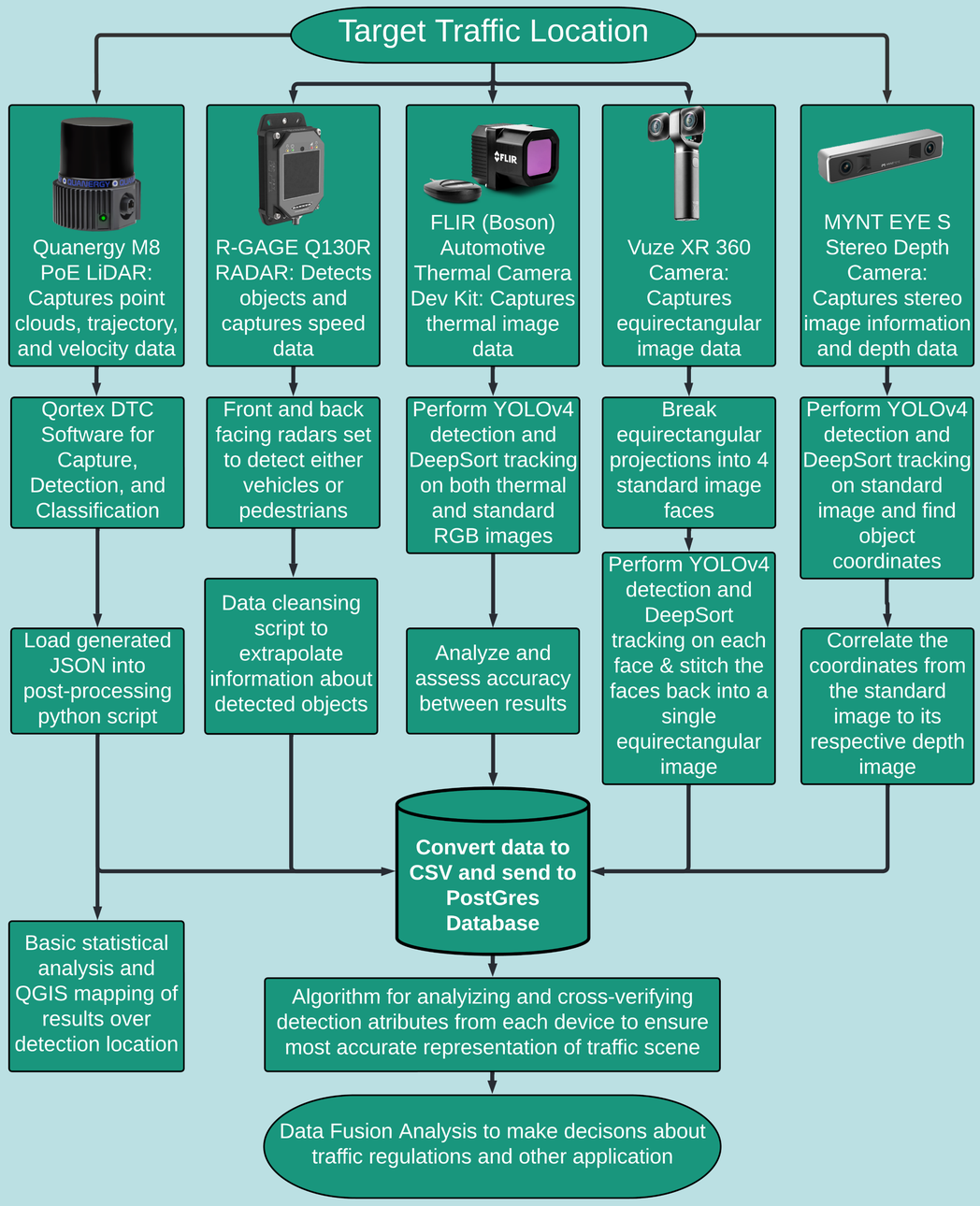
All-In-One Mount

To ensure convenience for future recording sessions, a model for a mobile mount was designed, also allowing consistent spacing of devices.

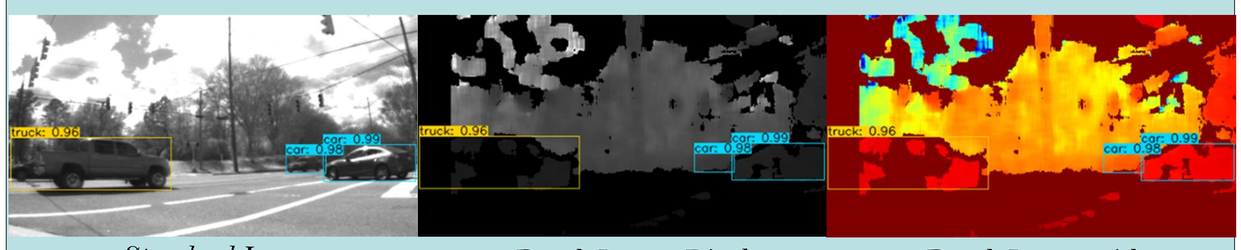
Data Capture Setup



Project Operation Process



1. Stereo Depth Camera Image and Detection



Standard Image | *Depth Image: Pixels Store Depth in mm* | *Depth Image with Colormap Overlay*

The stereo depth camera allows the capture of depth information and provides insight into the third dimension. This allows the approximation of object size and calculation of velocity. Here, the brighter colors in the right two images correspond to greater depth.

2. LiDAR Pedestrian and Vehicle Tracking on QGIS Mapping

QGIS mapping visualized the LiDAR data into a more easily interpreted form. This data can be used to quickly visualize object pathing in the area under observation and help decision makers enact policies appropriately, such as potential conflict locations. In this scene, pedestrian movements are being tracked.

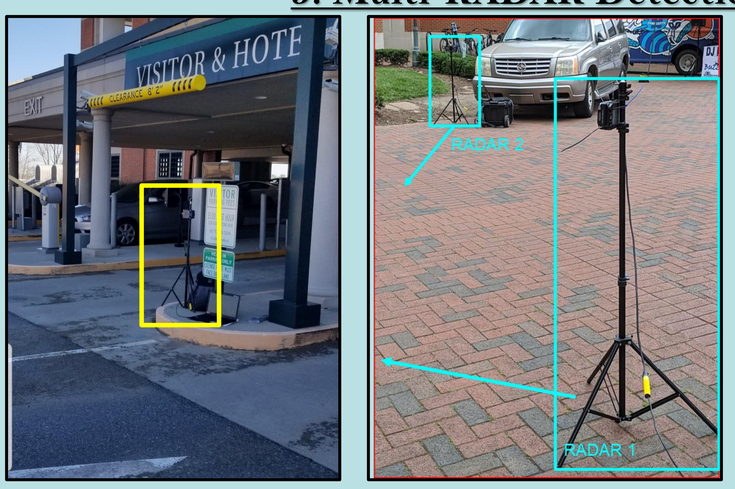
3. Sample 360 & LiDAR Detection

The 360 camera and LiDAR devices complement one another, allowing visual confirmation of LiDAR's abstracted detections. The diagram shows an intersection at the city of Apex.

4. Thermal Camera Advantage Demonstration

The thermal camera offers detection advantages in several low visibility scenarios: darkness, glare, weather, and more…
Here a pedestrian and a dog can be detected where other devices would fail.

5. Multi-RADAR Detection



Utilizing signals sent towards the target from various angles, the RADARs can detect any object on the road. The features found from targets (e.g., amplitude, distance, velocity) can be used to classify objects using ML

Applications and Discoveries

The Transportation Infrastructure Perception System developed by this project has several real-world applications. One application is traffic safety. This solution could be deployed to intersections to gather data on safety violations, allowing traffic engineers to improve traffic safety with a data-driven approach. Other applications could be simulations and 3D reconstruction. The collected data is used to build better models for simulating realistic traffic behavior, allowing greater confidence in the planning of infrastructure and roadways. Automation of device and data processes have been a challenge and could be improved upon in future iterations and data fusion to better serve these applications.

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