Transportation Infrastructure Perception Data Fusion and Detection Using AI Technology
UNCC Senior Design II Spring 2022 | Hosted & Supported by Systems Engineering and Engineering Management (SEEM) Department

**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.

**Data Capture Setup**

**Project Operation Process**

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.

1. **Stereo Depth Camera Image and Detection**
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.

**Contact Information**

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The UNCC Senior Design II Spring 2022 project focused on utilizing a variety of sensors for detecting and tracking mixed traffic objects. The data was cleansed through machine learning algorithms and collected on a database for traffic safety analysis. A model for a mobile mount was designed to ensure convenience for future recording sessions, allowing consistent spacing of devices. Examples of data capture setups included stereo depth camera, LiDAR, 360 camera, and thermal camera. QGIS mapping visualized the LiDAR data into an easily interpreted form, allowing quick visualization of object pathing and helping decision makers enact policies. Applications and discoveries included traffic safety improvements and simulations, with a focus on enhancing traffic safety through data-driven approaches.