AutoAlert

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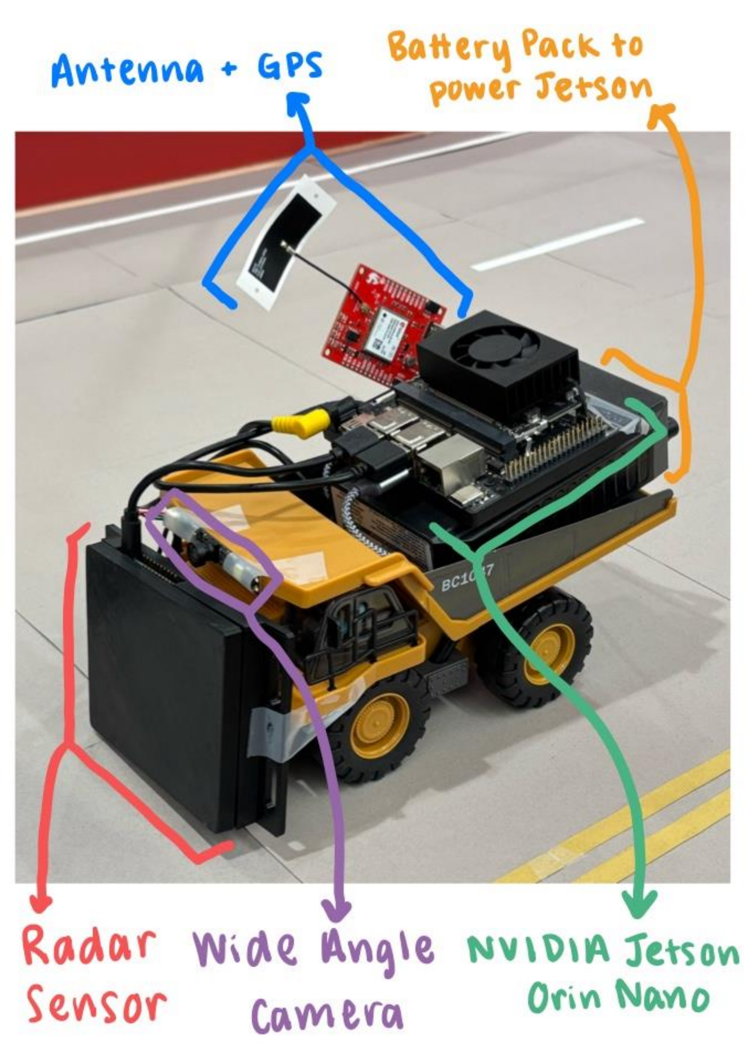
Product Pitch

AutoAlert provides a dashcam-esque car plugin to provide high-end safety features at a significantly lower price point, bridging a socioeconomic gap to increase car safety accessibility. Specifically, AutoAlert brings users three features: (1) traffic light detection (TLD) that notifies drivers when the traffic light changes from red to green, (2) lane detection (LD) to assist traffic light detection in multi-lane settings, and (3) forward car departure (FCD) detection that notifies drivers when the forward car has driven away. Our 90% accuracy for lane detection was **exceeded** with 97% accuracy, and our 90% accuracy for traffic light detection was **met**, notifying users in 472.8ms. Additionally, our 90% accuracy for forward car departure was **exceeded** with 95% accuracy, notifying users in 355µs, **more than 2,000x faster** than our requirement of 800ms!

System Description

Full System Mounted onto RC Car

In the green, our NVIDIA Jetson Orin Nano provides the computation behind the entirety of the software in our project, powered by our battery pack in orange. Our wide-angle camera in purple captures all of our video input, our radar sensor in red captures all of our distance measurements, and our antenna + GPS in blue captures our speed data.

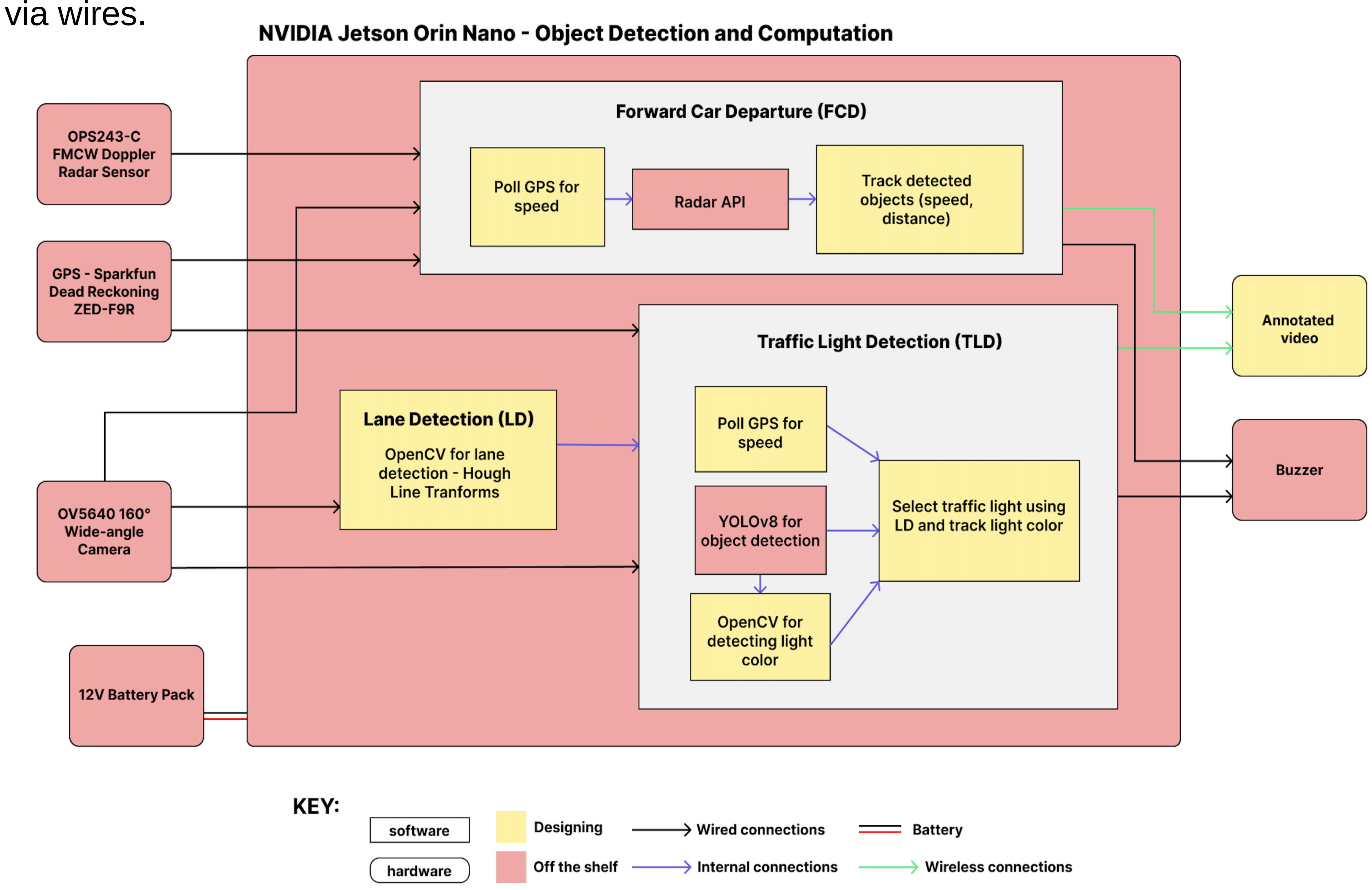


TLD in demo setup

LD in car setup

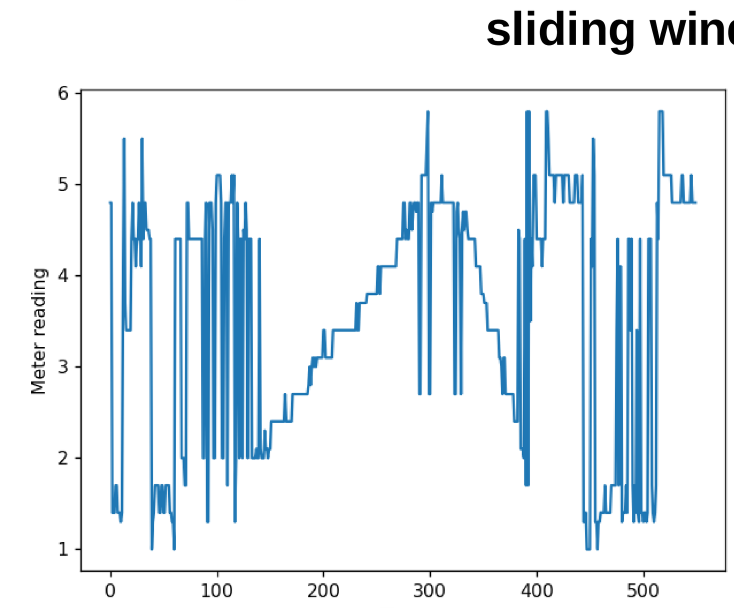
System Architecture

Our main inputs consist of hardware pieces that our system relies on. This consists of a GPS to detect the speed of the user, a radar that detects the car in front of the user and its relative speed and distance, and a wide-angle camera that our features parse and analyze through. These inputs are wired to the NVIDIA Jetson Orin Nano via USB connection, where our computation is performed. The Jetson Orin Nano is powered through a 12V battery pack. The radar, GPS, and camera are used for the FCD. The camera is used for LD, and the output of LD, the GPS and the camera are utilized for the TLD feature. The FCD and TLD output both video as well as an audio cue for the user to be notified. The video is transmitted wirelessly to a laptop, and the buzzer is connected via wires.

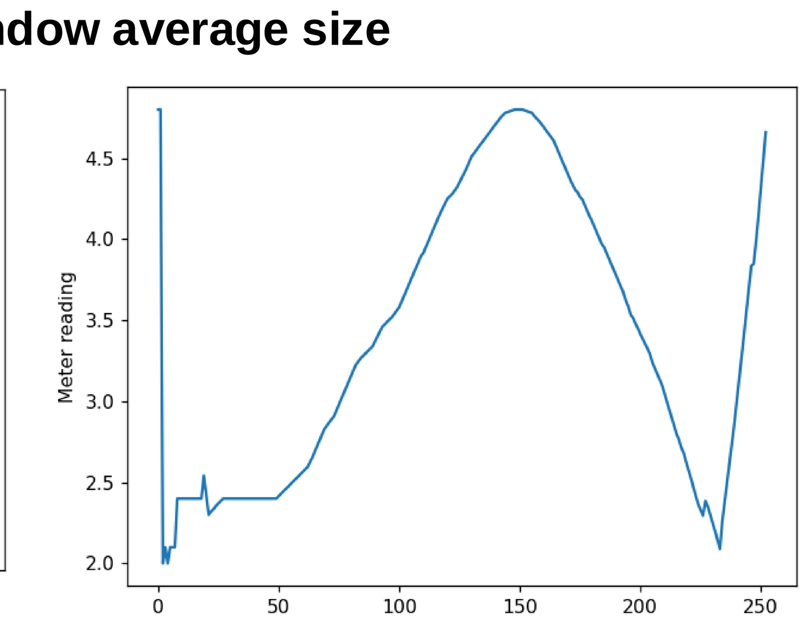


System Evaluation

Radar smoothing with numbers showing the 41% decrease in variance by changing sliding window average size



Before smoothing



After smoothing

Requirements:

Metric	Target	Actual
Indoor FCD Accuracy	90%	100%
Outdoor FCD Accuracy	90%	95%
FCD Notification Latency	800ms	355µs
LD Detection Accuracy	90%	97%
LD Latency	200ms	45.49ms
TLD General Accuracy	90%	90%
TLD Color Accuracy	100%	100%
TLD Latency	800ms	472.8ms

Conclusions & Additional Information

https://course.ece.cmu.edu/~ece500/projects/f24-teama4/

Our team faced a lot of setbacks with debugging our Jetson's OS and ideating how to build software to supplement our less reliable radar and camera. Although this was challenging, we learned how to quickly prioritize features by descoping our original plan to optimize more robust performance despite fewer features. We developed fast planning and decision-making skills to push through while being short on time, and we are very proud of our results in the face of the setbacks we experienced! In the future, we would love to see our forward collision detection implemented, since that was the feature we descoped.

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