AutoVot

A Vehicle to Vehicle Communication System for Autonomous Driving

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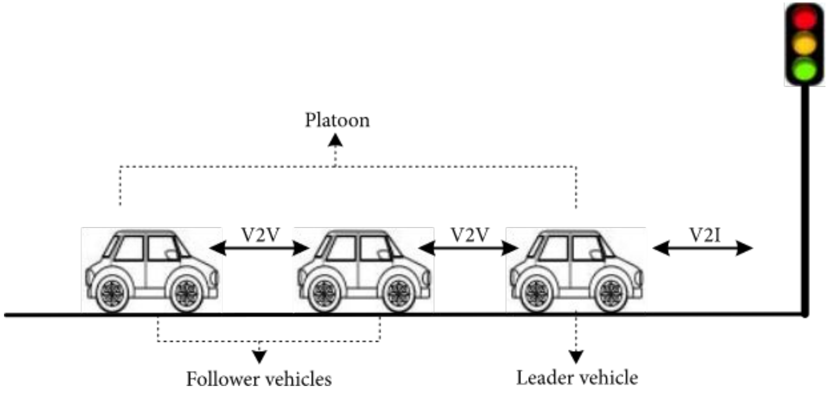
Why Vehicle to Vehicle Communication?

- Autonomous transportation looks to be the future mode of transport
- Self driving systems presently focus on a **single** vehicle performing an **independent** task
- Vehicle to Vehicle Communication (V2V) can enable **coordination** between autonomous vehicle allowing for **joint** perception and prediction
- Benefits of such systems would include transportation efficiency and added safety

Our Application

- A convoy system with a lead car and trail car with the goal of navigating from one location to another
- RC Vehicles will coordinate task by sending messages to each other to aid in perception and prediction



Requirements: RC Mechanical System

Physical System

- Bluetooth enabled 4WD RC Car system
- Payload capacity of ~2.5lbs (Compute Systems, Motor controllers, Imaging devices, etc.)
- Top speed of +3mph

Power system

- 5V Power delivery system for drive train (Microcontroller, Motor Shield, Motors)
- 5V Power delivery System for onboard compute system (Nvidia Jetson, Imaging devices)

Requirements: Autonomous Driving

General

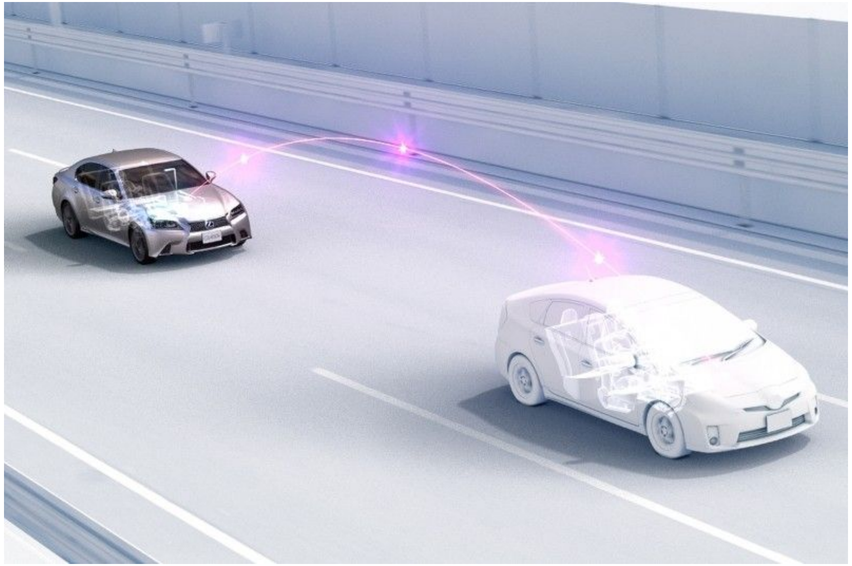
- 0 collisions
- 95% accuracy in static object detection
- Control input latency of 10Hz

Hardware

- LIDAR, IMU, ODOM (hall effect sensor) stack for perception
- LIDAR sensor update frequency: ~10Hz
- LIDAR sensor scan range: ~6m
- ODOM sensor update frequency ~30Hz
- Camera with video processing latency ~500ms

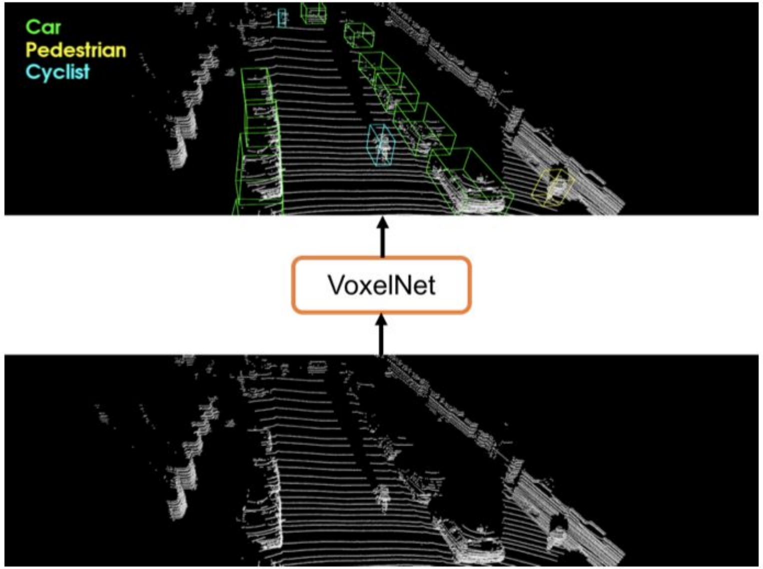
Requirements: V2V Communication Protocol

- Cars synchronize via message passing
- Messages should contain information to aid navigation process



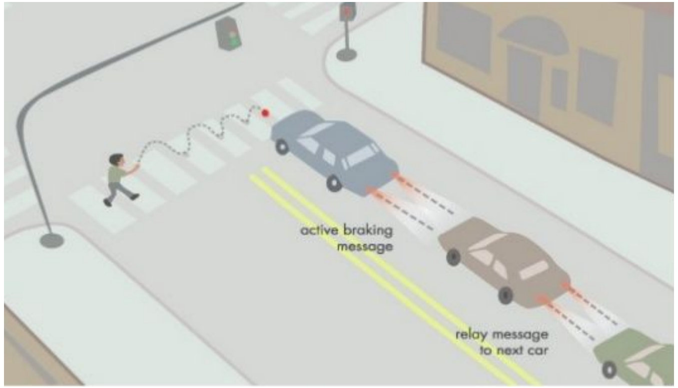
Technicalities: Autonomous Navigation

- LIDAR point clouds processed by Jetson
- Detection using VoxelNet trained on KITTI data
- Computation and control performed on board
- Alternative: camera and VGGNet for object recognition and marked objects

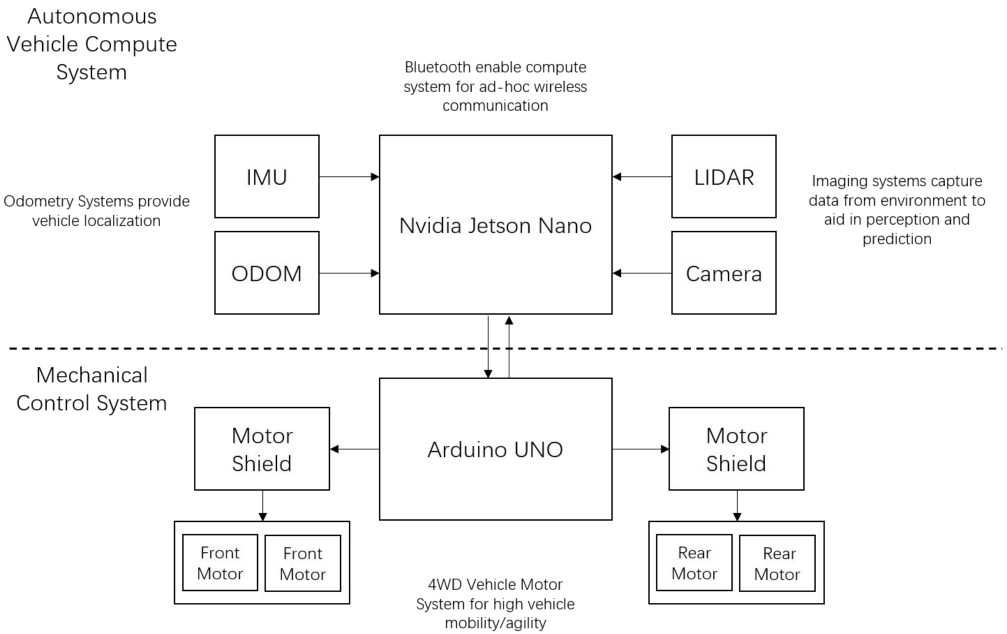


Technicalities: V2V Communication

- Bluetooth Ad Hoc Network
- Range ≈ 10m
- Messaging frequency ~2-4hz



Solution Approach



Item	Projected Cost
RC Vehicle Systems (x3)	$150
Imaging Sensor (LIDAR + Camera)	$150
ODOM + IMU	$20
NVIDIA Jetson (x3)	$180
Misc (Shipping, replacements, etc)	$70
TOTAL	**~$570**

Testing Verification and Metrics

- Individual latencies (LIDAR update, communication , control input latency) will be tested using timing libraries
- Object detection ability will be verified using up to 3 static obstacles from stationary and moving RC vehicles
- Communication will be tested with stationary RC cars separated at 10m

Tasks & Division of Labour

	RC Vehicle	Object Detection	Path Planning	Wireless Comm.	Testing
Joel	■			■	■
Fausto	■	■			■
Jeffrey		■	■		■

Projected Schedule - Gantt Chart

WBS NUMBER	TASK TITLE	TASK OWNER	PCT OF TASK COMPLETE
1	Project Initiation		
1.1	Design Finalizations	Joel	70%
1.1	Design Finalizations	Jeffrey	50%
1.1	Design Finalizations	Fausto	33%
1.3	RC car Assembly	Joel	0%
1.4	RC car Assembly	Fausto	0%
1.5	Setup Optical Sensor	Jeffrey	0%
2	Project Definition and Planning		
2.1	Object Detection	Jeffrey	0%
2.2	RC Car Turns	Joel	0%
2.3	RC Car Breaks / Speedup	Fausto	0%
2.4	V2V Setup		0%
3	Project Launch & Execution		
3.1	Path Planning	Fausto	0%
3.2	Path Planning	Joel	0%
3.2.1	Path Planning	Jeffrey	0%
3.2.2	Full Integration	Jeffrey	0%
3.3	Full Integration	Joel	0%
3.3.1	Full Integration	Fausto	0%
4	Project Testing		
4.1	Testing	All	0%
4.2	Metrics	All	0%
4.3	SLACK	All	0%