TinyLidarNet: 2D LiDAR-based End-to-End Deep Learning Model for F1TENTH Autonomous Racing

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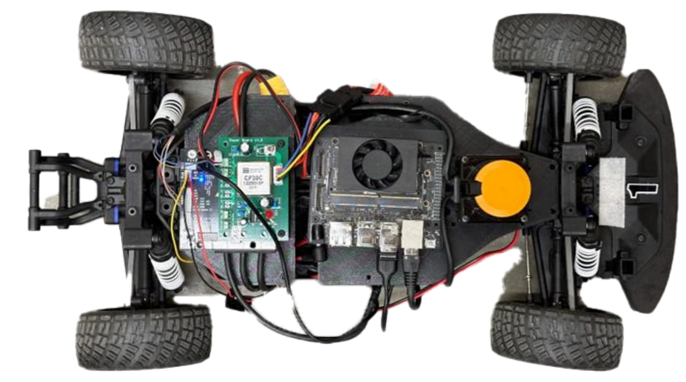

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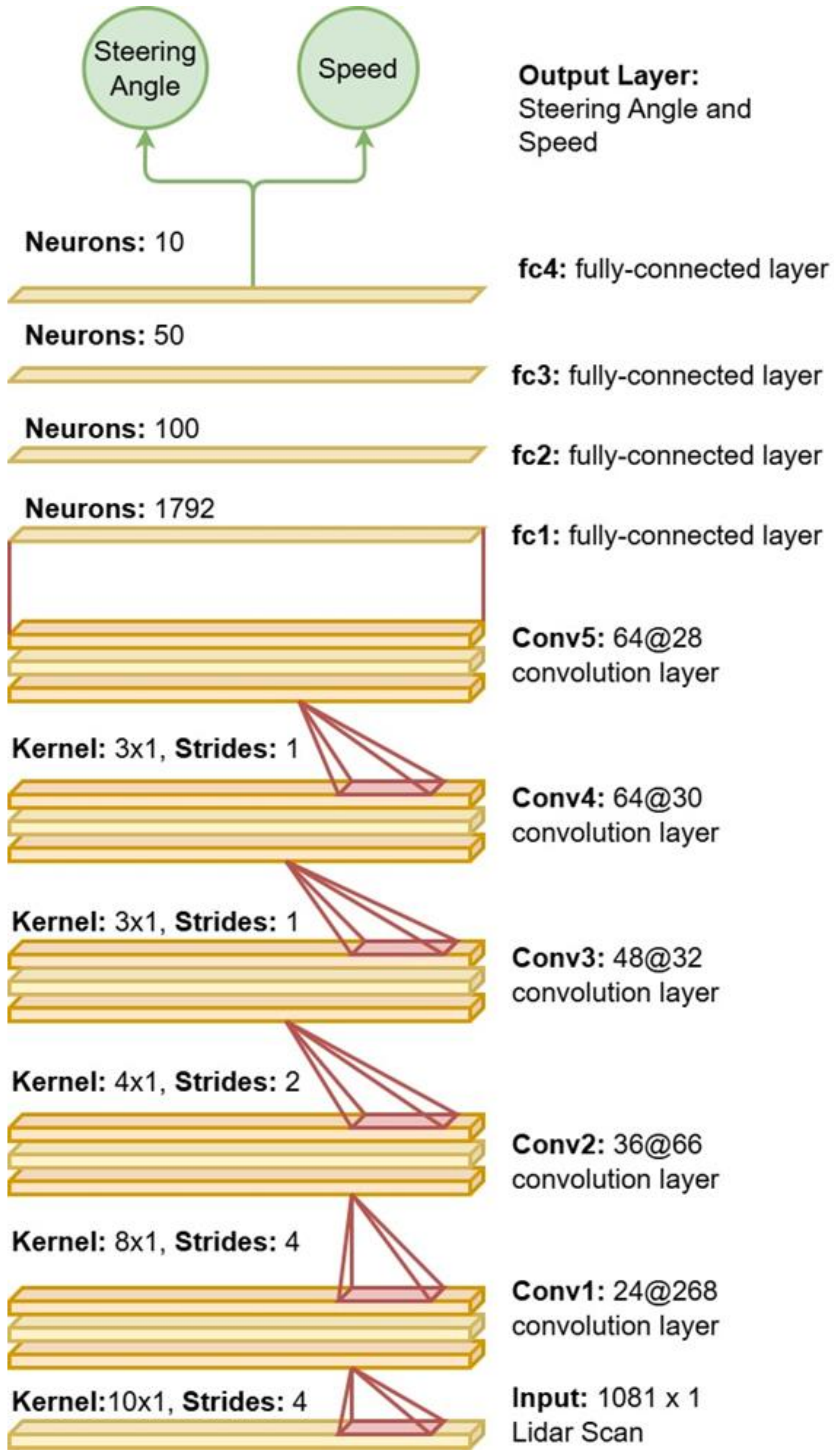
- We present **TinyLidarNet**, a 2D LiDAR-based end-to-end Convolutional Neural Network (CNN) architecture for F1TENTH autonomous racing.
- TinyLidarNet utilizes computationally efficient 1D CNN filters, which effectively capture spatial semantic of 2D LiDAR scans
- TinyLidarNet demonstrates *competitive performance* in real racing scenarios and *strong generalizability* on unseen tracks.

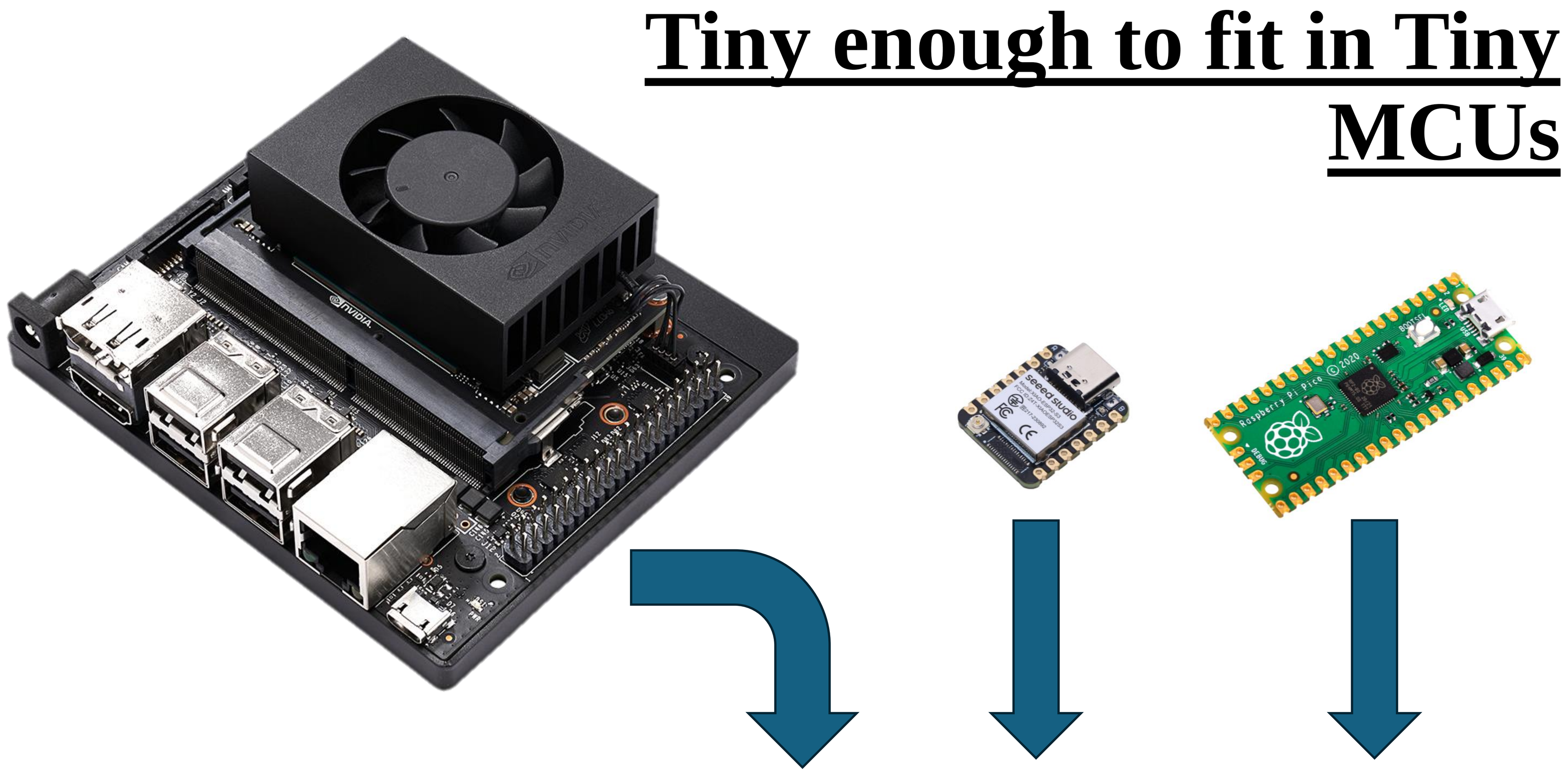
12th F1TENTH Racetrack

3rd Place out of 13 teams and demonstrated several advantages over traditional approaches

MACs: **1.5 M**, Parameters: **220K**

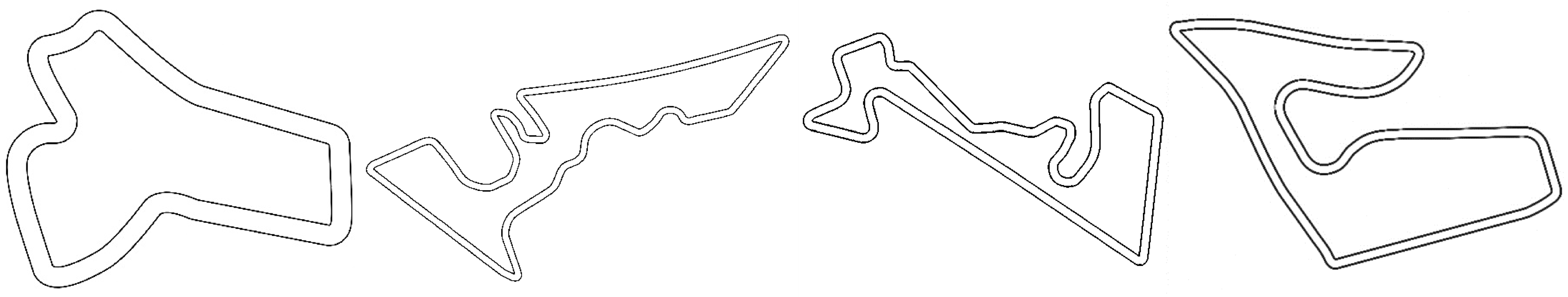


Tiny enough to fit in Tiny MCUs



Model Inference Time(ms)	Jetson NX	ESP32-S3	RPi Pico
TinyLidarNet^{L} (fp32)	<1	838	2642
TinyLidarNet^{L} (int8)	<1	16	196
TinyLidarNet^{M} (int8)	<1	8	91
TinyLidarNet^{S} (int8)	<1	4	36

Simulated Track Performance



F1tenth GYM Track (GYM) | Austin Track (AUS) | Moscow Raceway Track (MOS) | Spielberg Track (SPL)

	Average Lap Time (s)				Average Progress (%)			
Model	GYM	AUS	MOS	SPL	GYM	AUS	MOS	SPL
TinyLidarNet^{L}	25.8	85.7	63.3	65.3	100	100	100	100
TinyLidarNet^{M}	25.3	80	59.5	61.5	100	100	100	100
TinyLidarNet^{S}	26.9	83.4	61.8	64.1	100	100	100	100
MLP256^{L} [1]	N/A	N/A	58.8	58.3	31	16	42	61
MLP256^{M}	28.4	N/A	64.3	65.7	100	17	58	78
MLP256^{S}	27.6	N/A	N/A	62.2	77	48	29	37