Xailient

Case Study

Xailient Edge AI Computer Vision has a significantly smaller Carbon Footprint than Cloud AI

Synopsis

AI-powered IoT cameras are on track to add over 4 trillion kilograms in annual carbon dioxide emissions (Kg CO2e) by 2030, the equivalent of adding 860 million cars to the road in a decade.

Better AI has the potential to reduce these emissions significantly.

Key Outcomes

- ✓ Better AI can save **98.8% of carbon emissions** than regular AI-powered IoT cameras.

Problem Statement

IoT devices, like all electronics, consume power. But the internet-connected nature of these devices means that much of the carbon impact is not apparent from the owner's electric bill. Network connectivity and cloud-based AI contribute to the total carbon footprint.

Activity

Edge devices consume substantially less power than cloud devices.
Here's what we found:

1. An Edge device with a camera produces 4kg of CO2 per year.

	Kg CO2/year	Cameras per device
Edge Device [1] (We assume that 1 edge device uses 4 cameras)	14.6	4
Edge Device with 1 camera	3.65	1

* 1We assume the use-case requires near real-time framerate. Since we can already achieve ~24 FPS on a single RPi3B+ core, then max capacity per RPi3B+ is 4 near real-time cameras since it has 4 cores.

2. Network Access produces 123kg CO2 per year.

CLOUD ACCESS TECHNOLOGIES	4G	WiFi	Wired
Power consumption per use (in microJoules/bit) [2]	73	0.4	0
Power consumption per use for core network (in microJoules/bit) [2]	0.64		
Total power consumption per network access (in microJoules/bit)	73.64	1.04	0.64
Bits used per year [3]	122,990,400,000,000		
Power consumption for network access per year (in microJoules/bit)	9.06e+15	1.28e+14	7.87e+13
Power consumption for network access per year (in GigaJoules/bit)	9.06	0.13	0.08
CO2 per GigaJoule of energy (in Kg) [4]	40		
CO2 produced for network access per year (in Kg)	362.2805222	5.12	3.14855424
ON AVERAGE, FOR NETWORK ACCESS, CO2 PRODUCED PER YEAR (in Kg)	123.52		

3. Cloud Inference produces 168kg CO2 per year.

	Kg CO2/year	Cameras per device
Cloud Inference [5]	993.4	5
Cloud Inference with 1 Camera per device	198.7	1

* We assume that to achieve the same near real-time frame-rate (~24 FPS) per camera as the reference RPi3B+, a cloud GPU (without Xailient's DNN) would only manage 5 cameras using YOLOv3 (since a YOLOv3 inference on a Titan X GPU (much faster than K80) is only 34 ms/frame on average).

Results

Market Size

The number of IoT devices is expected to reach 125-500 billion by 2030, and assuming that 20% of them will have cameras, IoT devices with cameras is a **13-100 billion unit market**. Considering that 12% of the market has Xailient Edge AI, **500 million tonnes of CO2 will be saved annually** by 2030.

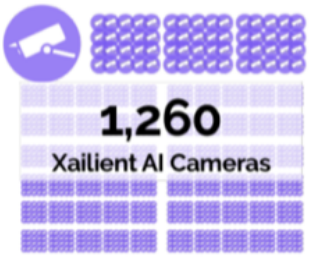
20% of IoT devices have cameras

By 2030	IoT Devices	IoT with Camera	Xailient Market	IoT with Xailient AI	Tonns CO2 Saved
(Purdue) [8]		13 billion	12%	1.6 billion	500 million
(IHS Markit) [6]	125 billion	25 billion	7%	1.6 billion	500 million
(Cisco) [7]	500 billion	100 billion	2%	2 billion	644 million

End-to-end Savings

Each AI Camera device produces 4 KgCO2e per year. With Cloud AI, the network for data transmission produces 123 Kg of CO2 per year, and Cloud inference produces 198 Kg CO2e per year. In contrast, with edge AI, networking and cloud are not required as processing takes place at Edge device, closer to the data source, thus **saving 98.8% of CO2 production per year**.

Each AI Camera	Device	Networking	Cloud	Annual Total
Cloud AI	4 Kg CO2e/Year	123 Kg CO2e/Year	198 Kg CO2e/Year	**325** Kg CO2e/Year
Edge AI	4 Kg CO2e/Year	0	0	4 Kg CO2e/Year



Next Steps

Xailient saves 321 KgCO2e per AI camera device per year. A US car & fuel produces about 60,000 KgCO2e in its lifetime and produces 4600 Kg CO2e per year. With 15 Xailient AI installs, **Xailient can save one car equivalent of CO2.**

Discussion

Xailient Computer Vision systems that are so efficient they can run at the edge, even on existing hardware. When deploying new hardware, the Detectum software allows for smaller chips. Less computation and smaller hardware. This means **AI with a smaller carbon footprint**, and Edge deployment means less waste in transmitting data.