# XiNets for Edge Keypoint Detection

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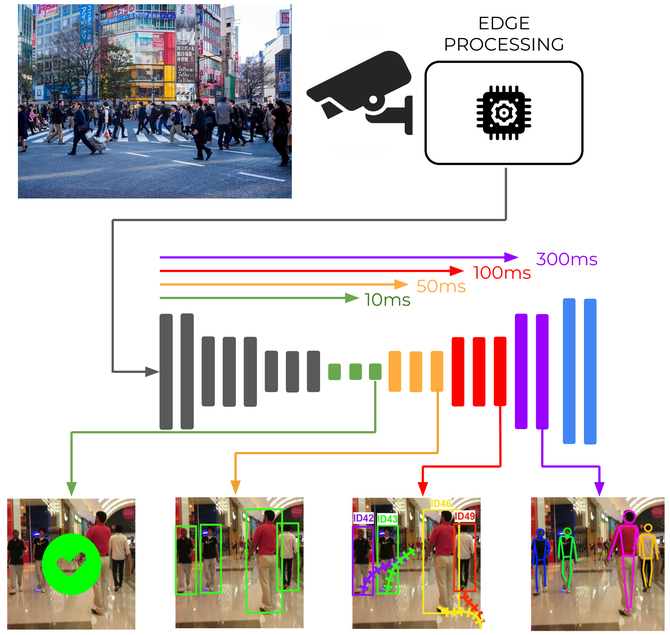
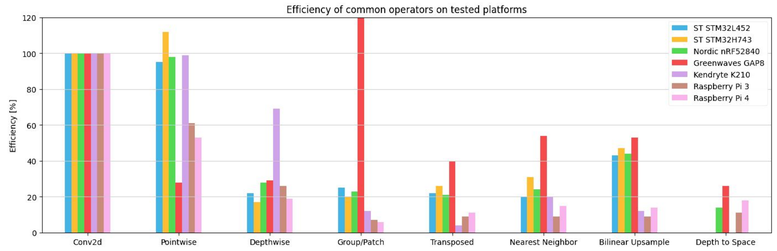
FONDAZIONE BRUNO KESSLER

## Edge Video Analytics




Objective: **Video analytics** on edge and IoT devices
Networks must be:

- **Efficient**: Low power consumption for battery powered devices
- **Lightweight**: Able to run in real time on MCUs and edge devices
- **Adaptable**: Easy to scale to different resource constraints



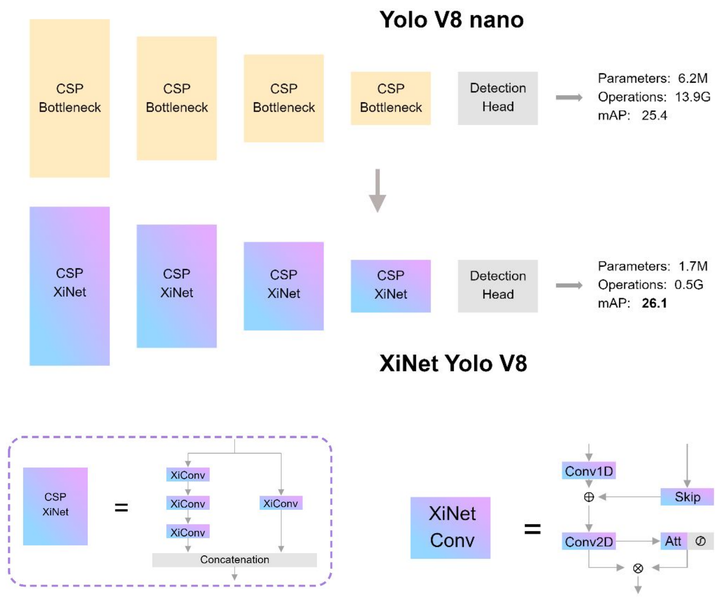

## XiNet + Yolo-pose

Building blocks: XiNet Convolutions, built from a set of maximally efficient operators.

- **Efficient**: From real-world measurements
- **Lightweight**: >80% fewer ops than Conv2D
- **Adaptable**: Allow for Hardware Aware Scaling

Hardware Aware Scaling: three hyperaparameters allow to disjointly optimize FLASH, RAM, MAC.

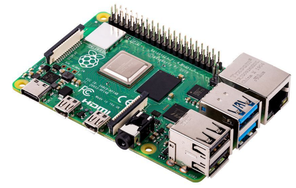
- **Alpha** : Width factor, sets MAC
- **Beta**: Shape factor, sets FLASH
- **Gamma**: Compression ratio, sets RAM




## Results

Networks scaled using Hardware Aware Scaling to fit different classes of devices:

- **MCU**: STM32H7 - 100MMAC/s, 2MB Flash, 1MB Ram
- **TPU**: K210 - 1GMAC/s, 16MB Flash, 5MB Ram
- **MPU**: Raspberry Pi 4B - 16GMAC/s, 16GB SD, 4GB Ram

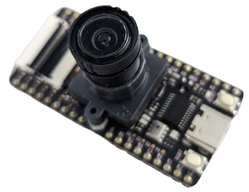


**Raspberry Pi 4B:**

-Network Configuration:
α= 1.0 β= 1.0 γ=4.0

-Resource Utilization:
MMAC= 6112 M
Parameters= 3.2 M
RAM= 1.21 M

-Performance: **72.6 mAP**
-Energy: **1989 mJ/frame**



**Kendryte K210:**

-Network Configuration:
α= 0.75 β= 1.0 γ=4.0

-Resource Utilization:
MMAC= 859 M
Parameters= 1.8 M
RAM= 622 K

-Performance: **71.2 mAP**
-Energy: **410 mJ/frame**

**ST STM32H743:**

-Network Configuration:
α= 0.33 β= 0.8 γ=5.0

-Resource Utilization:
MMAC= 62M
Parameters= 1.2 M
RAM= 180 K

-Performance: **70.1 mAP**
-Energy: **33.4 mJ/frame**