NVIDIA®Jetson Nano

Reading group

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Jetson Nano Developer Kit

Figure 2: Structure

GPU	128-core Maxwell
CPU	Quad-core ARM A57 @ 1.43 GHz
Memory	4 GB 64-bit LPDDR4 25.6 GB/s
Storage	microSD (not included)
Video Encode	4K @ 30 | 4x 1080p @ 30 | 9x 720p @ 30 (H.264/H.265)
Video Decode	4K @ 60 | 2x 4K @ 30 | 8x 1080p @ 30 | 18x 720p @ 30 (H.264/H.265)
Camera	2x MIPI CSI-2 DPHY lanes
Connectivity	Gigabit Ethernet, M.2 Key E
Display	HDMI and display port
USB	4x USB 3.0, USB 2.0 Micro-B
Others	GPIO, I^2C, I^2S, SPI, UART
Mechanical	69 mm x 45 mm, 260-pin edge connector

Figure 3: Spécificités techniques

Jetson Nano 2GB Developer Kit

Figure 4: Structure

GPU	128-core NVIDIA Maxwell™
CPU	Quad-core ARM® A57 @ 1.43 GHz
Memory	2 GB 64-bit LPDDR4 25.6 GB/s
Storage	microSD (Card not included)
Video Encode	4Kp30 | 4x 1080p30 | 9x 720p30 (H.264/H.265)
Video Decode	4Kp60 | 2x 4Kp30 | 8x 1080p30 | 18x 720p30 (H.264/H.265)
Connectivity	Gigabit Ethernet, 802.11ac wireless†
Camera	1x MIPI CSI-2 connector
Display	HDMI
USB	1x USB 3.0 Type A,2x USB 2.0 Type A, USB 2.0 Micro-B
Others	40-pin header (GPIO, I2C, I2S, SPI, UART) 12-pin header (Power and related signals, UART) 4-pin Fan header†
Mechanical	100 mm x 80 mm x 29 mm

Figure 5: Spécificités techniques

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- **Prix** : entre 60 et 200$ pour le 2 GB et entre 100 à 400$ pour le 4 GB

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- **Ventilateur** : Problèmes de ventilateur sur la 4 GB
- **Cluster** : Etre capable de transmettre les données avec les raspi/ l'autre jetson

Exemples d'applications

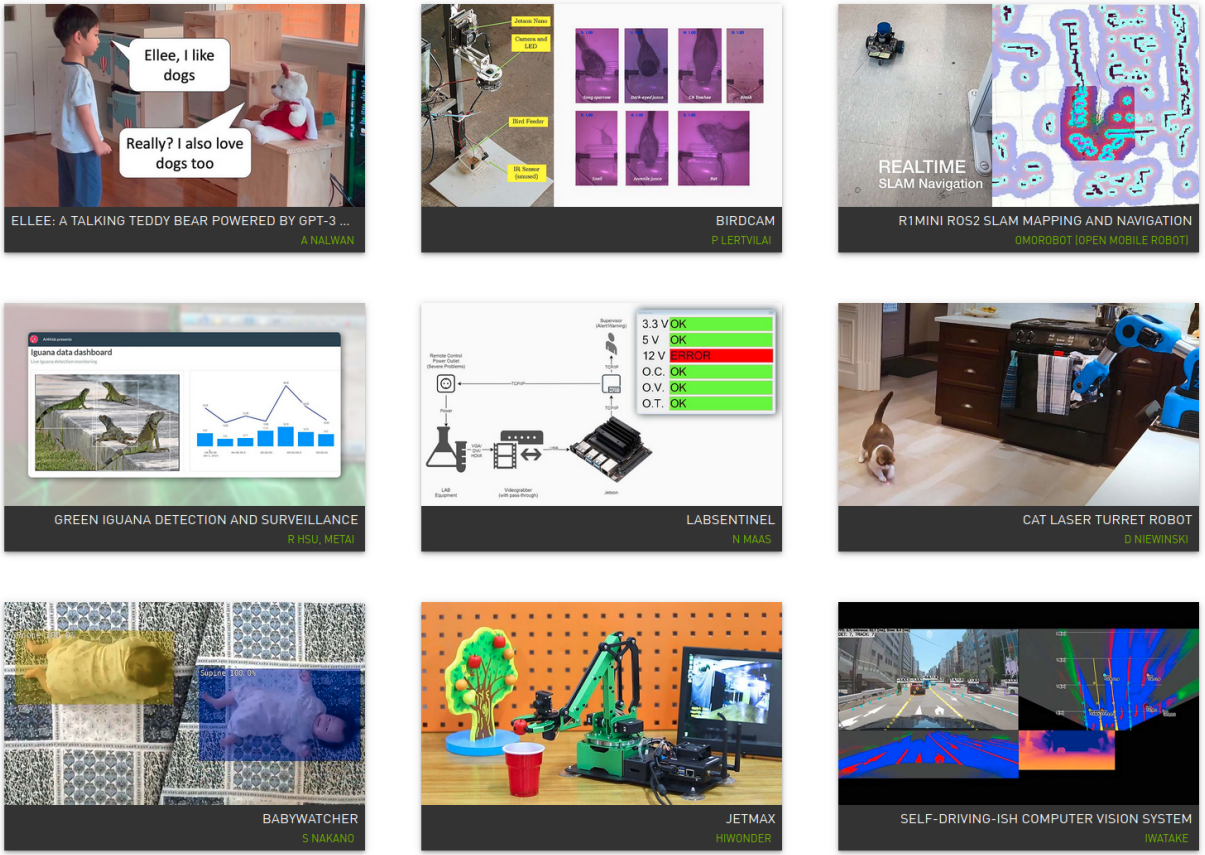

Figure 6: Gallerie de la communauté

Reconnaissance vocale

Objectif : Reconnaître la voix avec un micro et afficher la retranscription

- Utilisation de coqui.ai en inférence
- Modèle pré-entraîné commonvoicefr
- Connexion avec Raspi/Jetsons
- Mesure de la conso

Démonstration !

Outils disponibles

The tegrastats utility reports memory usage and processor usage for Jetson-based devices

```
pgay@pena:~$ tegrastats
RAM 469/1980MB (lfb 2x4MB) SWAP 387/5086MB (cached 30MB) CPU [0%@1224,0%@1224,0%@1224,0%@1224] EMC_FREQ 0% GR3D_FREQ 0% PLL@20.5C CPU@23.5C PMIC@50C GPU@23.5C AO@28.5C thermal@23.5C
RAM 469/1980MB (lfb 2x4MB) SWAP 387/5086MB (cached 30MB) CPU [0%@1224,0%@1224,0%@1224,0%@1224] EMC_FREQ 0% GR3D_FREQ 0% PLL@20C CPU@23.5C PMIC@50C GPU@23.5C AO@28.5C thermal@23.5C
RAM 469/1980MB (lfb 2x4MB) SWAP 387/5086MB (cached 30MB) CPU [1%@1224,0%@1224,0%@1224,0%@1224] EMC_FREQ 0% GR3D_FREQ 0% PLL@20.5C CPU@23.5C PMIC@50C GPU@23.5C AO@28.5C thermal@23.5C
RAM 469/1980MB (lfb 2x4MB) SWAP 387/5086MB (cached 30MB) CPU [1%@1224,0%@1224,0%@1224,0%@1224] EMC_FREQ 0% GR3D_FREQ 0% PLL@20.5C CPU@23.5C PMIC@50C GPU@23.5C AO@29C thermal@23.5C
RAM 469/1980MB (lfb 2x4MB) SWAP 387/5086MB (cached 30MB) CPU [0%@1224,0%@1224,0%@1224,0%@1224] EMC_FREQ 0% GR3D_FREQ 0% PLL@20C CPU@23.5C PMIC@50C GPU@23.5C AO@28.5C thermal@23.75C
RAM 469/1980MB (lfb 2x4MB) SWAP 387/5086MB (cached 30MB) CPU [0%@1224,0%@1224,0%@1224,0%@1224] EMC_FREQ 0% GR3D_FREQ 0% PLL@20C CPU@23.5C PMIC@50C GPU@23.5C AO@28.5C thermal@23.5C
RAM 469/1980MB (lfb 2x4MB) SWAP 387/5086MB (cached 30MB) CPU [0%@1224,0%@1224,0%@1224,0%@1224] EMC_FREQ 0% GR3D_FREQ 0% PLL@20C CPU@23C PMIC@50C GPU@23.5C AO@28.5C thermal@23.25C
```

Figure 7: tegrastats avec la jetson 2GB

Pas d'infos sur la consommation

Example Output for T210 Platforms

This example represents output for Jetson TX1 and Jetson Nano series:

```
RAM 220/3955MB (lfb 847x4MB) SWAP 0/1978MB (cached 0MB) IRAM 0/252kB(lfb 252kB) CPU
[1%@102,5%@102,0%@102,0%@102] EMC_FREQ 1%@665 GR3D_FREQ 0%@76 VIC_FREQ 0%@192 APE 25 PLL@34C CPU@35C
Tboard@38C Tdiode@40C GPU@37.5C AO@43.5C thermal@36C PMIC@100C
```

Example Output for T186 Platforms

This example represents output for Jetson TX2 series devices:

```
RAM 1756/7842MB (lfb 1262x4MB) SWAP 0/3921MB (cached 0MB) CPU [2%@345,off,off,0%@345,0%@345,0%@345]
EMC_FREQ 0%@665 GR3D_FREQ 0%@114 VIC_FREQ 0%@115 APE 150 PLL@45C MCPU@45C PMIC@100C Tboard@41C GPU@43.5C
BCPU@45C thermal@44.9C Tdiode@43C
```

Example Output for T194 Platforms

This example represents output for Jetson AGX Xavier series and Jetson Xavier NX devices.

```
RAM 1545/31919MB (lfb 7400x4MB) SWAP 0/15959MB (cached 0MB) CPU
[0%@1190,0%@1190,0%@1190,0%@1190,0%@1190,0%@1190,0%@1190,0%@1190] EMC_FREQ 1%@408 GR3D_FREQ 0%@318
VIC_FREQ 0%@115 APE 150 MTS fg 0% bg 0% AO@38C GPU@39.5C Tdiode@43.25C PMIC@100C AUX@38.5C CPU@39.5C
thermal@38.8C Tboard@39C GPU 0/0 CPU 468/468 SOC 937/937 CV 0/0 VDDRQ 312/234 SYS5V 1458/1458
```

Figure 8: Outputs

[VDD*X*] *Y*/*Z* VDDRQ 312/234 Power consumption of a power rail	Name of the power rail	Instantaneous power consumption in milliwatts	Average power consumption in milliwatts

Figure 9: Power rail consumption

Profiling Energy Consumption of DNN on NVIDIA Jetson Nano

"Different power measurement methods for embedded systems are discussed in [Overview, 2009].
In our case, we do not have access to ARM Streamline Performance Analyzer and will use only onboard sensors.
Calorimetric measuring methods, which are considered the most accurate measuring methods, were discussed. Due to the slow change of temperature and, therefore, long timing periods, this method does not seem to be feasible for our use case."
Mesure avec un oscilloscope et une résistance de dérivation
[Holly et al., 2020]

Power Monitor

Power Monitor Information

Applies to: Original Jetson Nano and Jetson TX1 only

The information from the INA3221 power monitor can be read using sysfs nodes. The naming convention for sysfs nodes is:

Command	Description
rail_name_<N>	Exports the rail name.
in_current<N>_input	Exports rail current in milliamperes.
in_voltage<N>_input	Exports rail voltage in millivolts.
In_power<N>_input	Exports rail power in milliwatts.
crit_current_limit_<N>	Exports rail critical current limit in milliamperes.
Where <N> is a channel number 0-2.	

Note: **The INA driver may also present other nodes. Do not modify any INA sysfs node value. Modifying these values can result in damage to the device.**

Jetson Nano 2GB does not have an INA3221 power monitor.

The sysfs nodes to read for rail names, voltage, current, power, and critical current limit are at:

- Jetson TX1: `/sys/bus/i2c/drivers/ina3221x/1-0040/iio:device0`
- Jetson Nano: `/sys/bus/i2c/drivers/ina3221x/6-0040/iio:device0/`

Figure 10: Pas de bol...

Wattmètre as usual

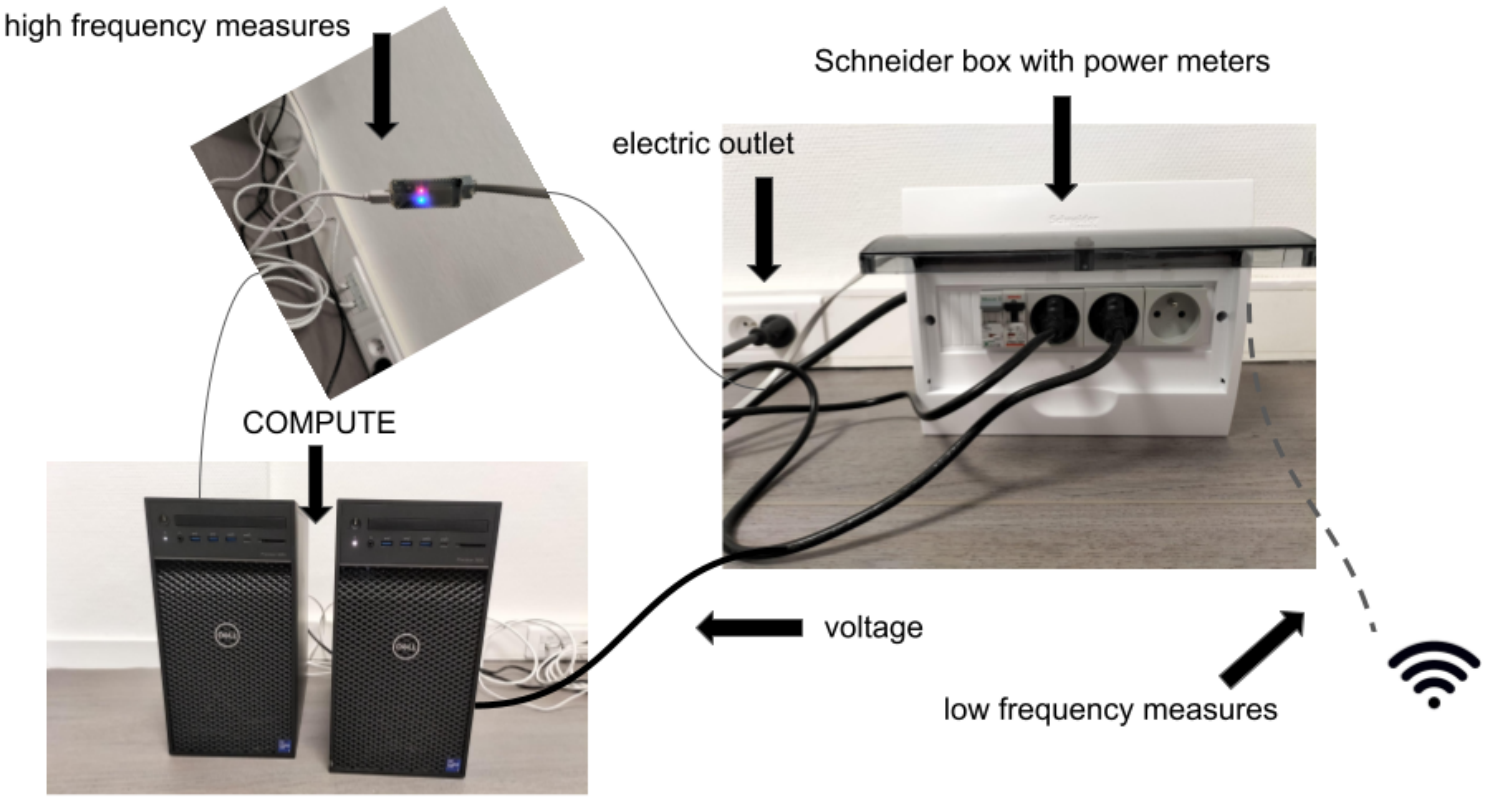

Figure 11: Il reste une prise disponible pour la jetson !

Thanks!

References I

[Holly et al., 2020] Holly, S., Wendt, A., and Lechner, M. (2020).
Profiling energy consumption of deep neural networks on nvidia jetson nano.

[Overview, 2009] Overview, E. S. P. C. M. M. (2009).
Zilvinas nakutis.