MaskCam: A Jetson Nano AIoT Mask Detection Camera

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Agenda

About us

MaskCam, an AI-enabled smart camera based around Jetson Nano

Software design and containerization

Hardware design and high volume productization

Conclusions and resources

About us

MaskCam: A mask detection smart camera

COVID-19 creates a **need to monitor crowd size** and **face mask usage** in public areas

MaskCam provides mask-wearing statistics in an indoor or outdoor area

Reference design for AI-enabled embedded vision applications


NO ENTRY

Software: AI model selection

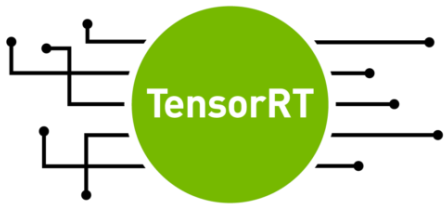
~~Pose Estimation + Classification~~
Object Detection

Object classes: **mask**, **no_mask**, **not_visible**

Tracking (Norfair)

*Original camera video: courtesy of **EarthCam***

Software: Optimized object detection



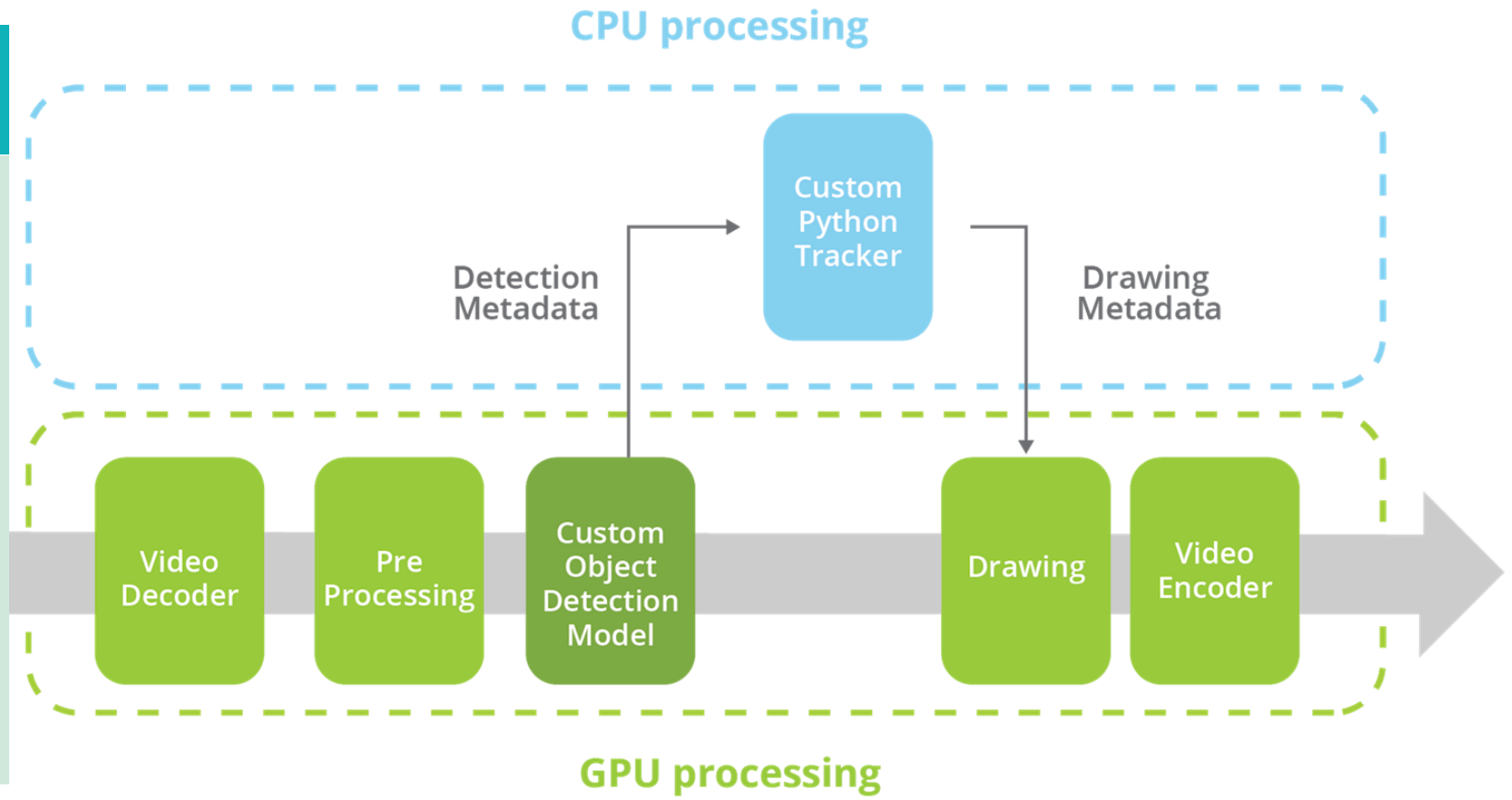
FP-16

	YOLOv4-full	YOLOv4-tiny	MobileNetV2
Input resolution	608x608	1024x608	1024x608
FPS (Jetson Nano)	2.5	14	6

Software: Video pipeline

Why DeepStream Pipeline?

- Hardware acceleration & parallelization
- Fast development (Python) + high performance (C, CUDA)
- Maximum performance (inference bottleneck)



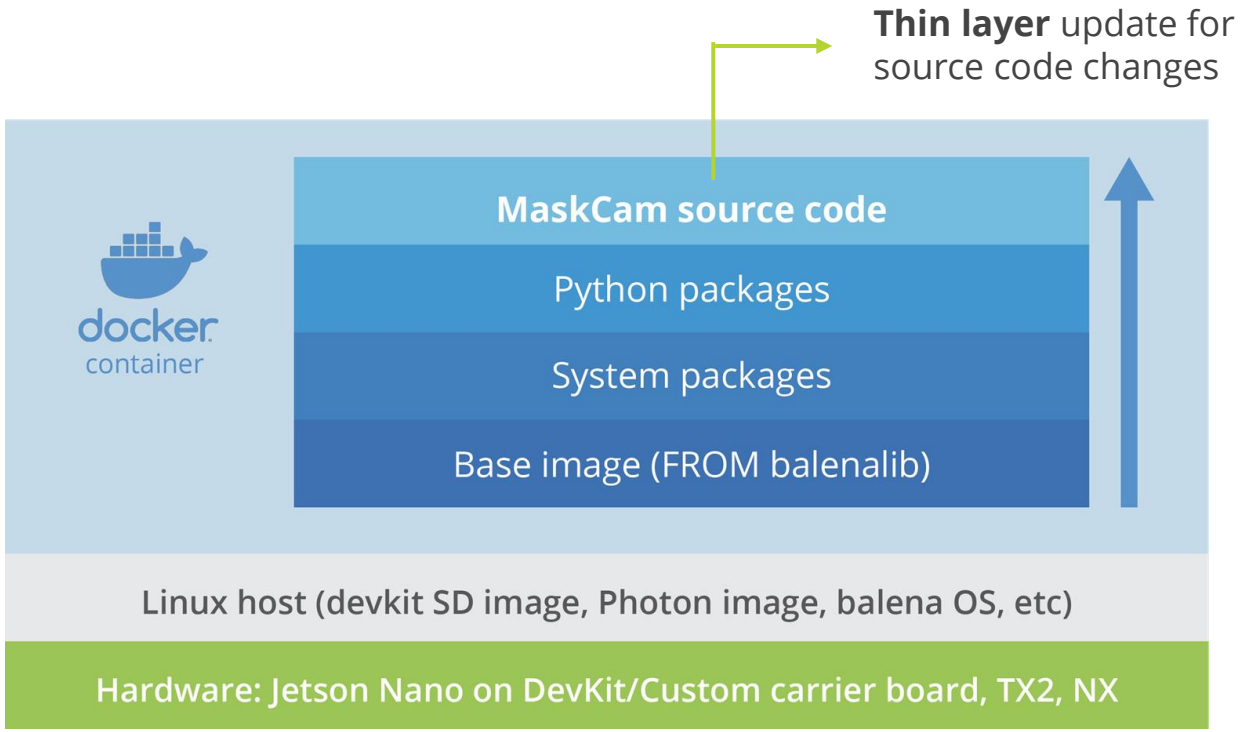
Other Requirements

- **Web server**
  - **Postgres** DB, **FastAPI** backend, **Streamlit** frontend
- **Remote communication**
  - **MQTT** protocol: send statistics, receive commands
- **Video streaming, save video snapshots**
  - Python **multiprocessing**
  - **UDP video** packets for internal sharing

Containerization

Why containers?

- **Dependencies** bundled together
- Better **reproducibility**
- **Hardware decoupling**
- Easy **over-the-air updates**
- Easily link to **balenaCloud**



MaskCam Hardware and Productization

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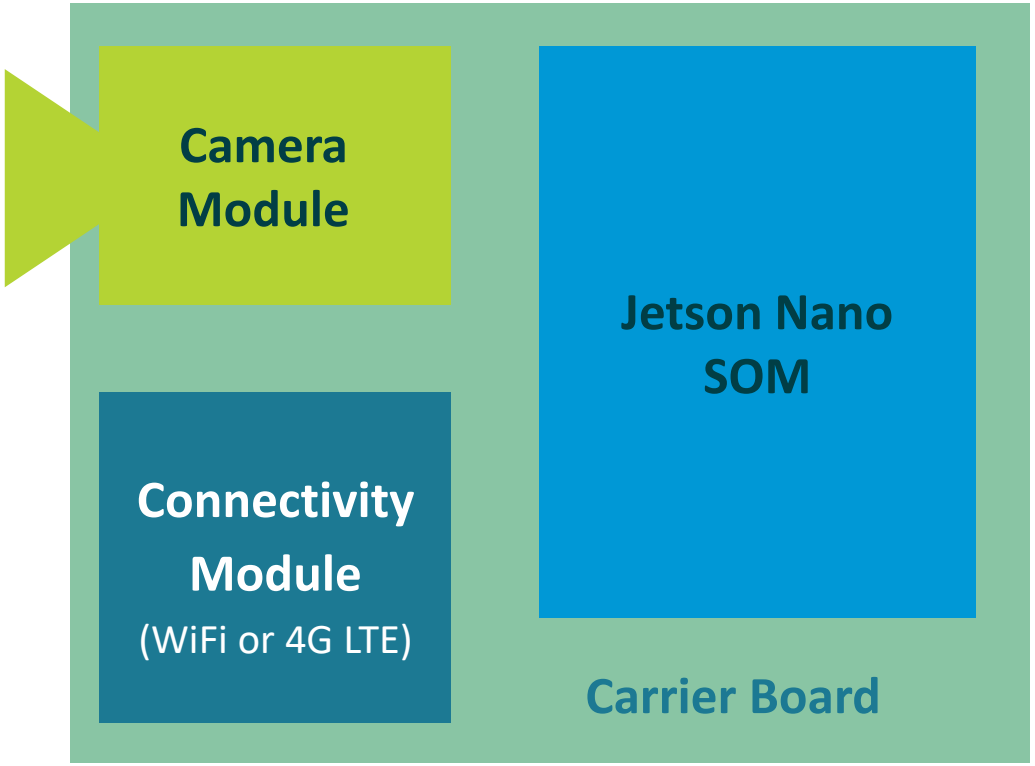
Hardware: Design

Primary components

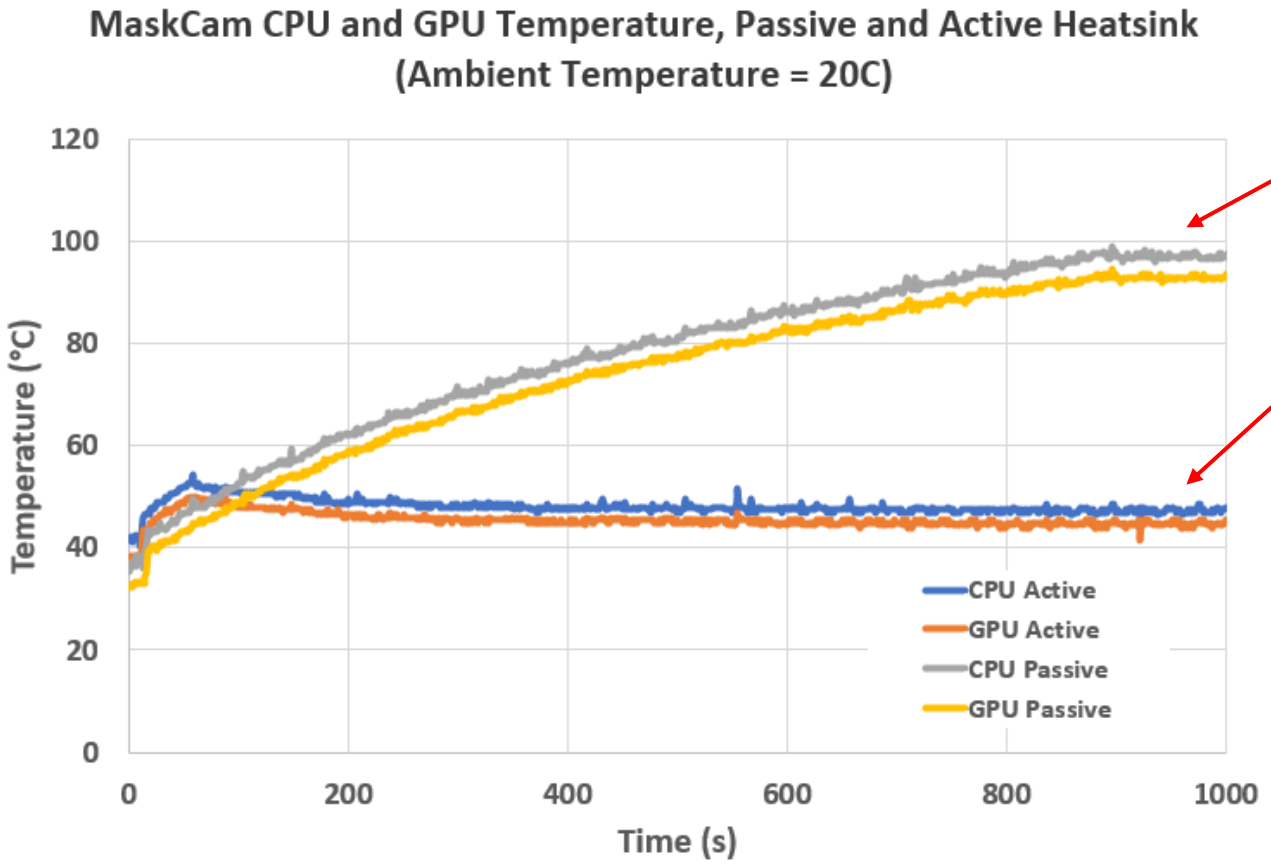
- Jetson Nano SOM
- Carrier board
- Camera module
- Connectivity module

NVIDIA resources

- Jetson Partner Hardware Products list
- Jetson Partner Supported Cameras list
- elinux.org/Jetson_Nano



Hardware: Thermal testing



No fan: *thermal throttling* causes **Degraded performance**

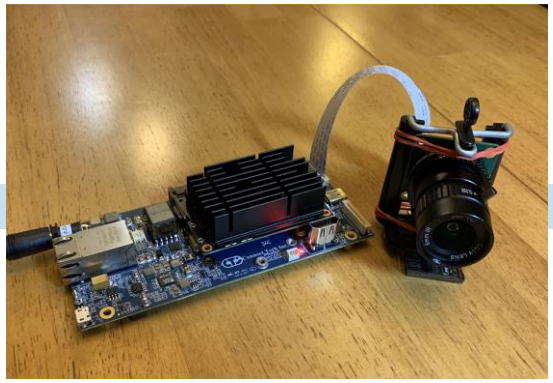
Active fan: stable temperature, **maximum performance**

Heatsink	Final CPU Temp	Final GPU Temp	Average Inference FPS
Passive	97°C	93°C	13.1
Active	48°C	45°C	14.2

Conclusion: final production design requires active heatsink

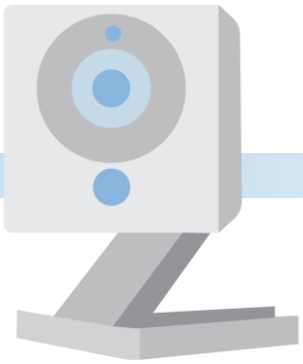
From prototype to high-volume production

Developer Kit



Off-the-shelf prototype kit

JABIL



Production model

Worked with Jabil to **determine next steps** for **turning MaskCam into a high-volume product** and get a preliminary cost estimate

Estimated BOM and production cost

Item	Cost (10K/year, USD)	Cost (100K/year, USD)
Jetson Nano	$99.00	$89.00
Camera Module	$42.36	$33.84
Carrier Board	$54.82	$53.13
Enclosure, Fan	$41.20	$35.29
Total BOM Cost	**$237.38**	**$211.26**
Production Cost (MVA)	$118.69	$84.51
Overall Cost	**$356.07**	**$295.77**

MaskCam is open source!

Step 1. Pull the Docker container

```
nano@nano-desktop:~$ sudo docker pull maskcam/maskcam-beta
```

Step 2. Run MaskCam

```
nano@nano-desktop:~$ sudo docker run --runtime nvidia --privileged --rm -it --
env MASKCAM_DEVICE_ADDRESS=<your-jetson-ip> -p 1883:1883 -p 8080:8080 -p
8554:8554 maskcam/maskcam-beta
```

github.com/bdtinc/maskcam

(MIT License)

Available resources

GitHub repository
github.com/bdtinc/maskcam

Independent report
bdti.com/maskcam

Us!
bdti.com
tryolabs.com

Come see our demos and talk to us live!

Questions?

Email us:
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