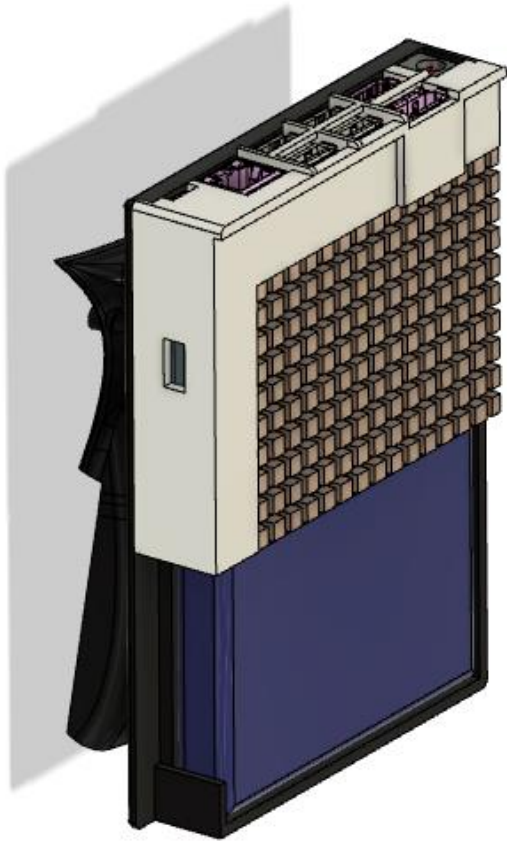


Robotics Practical

Nano-backpack designed for humanoid NAO robot



Mechanical design



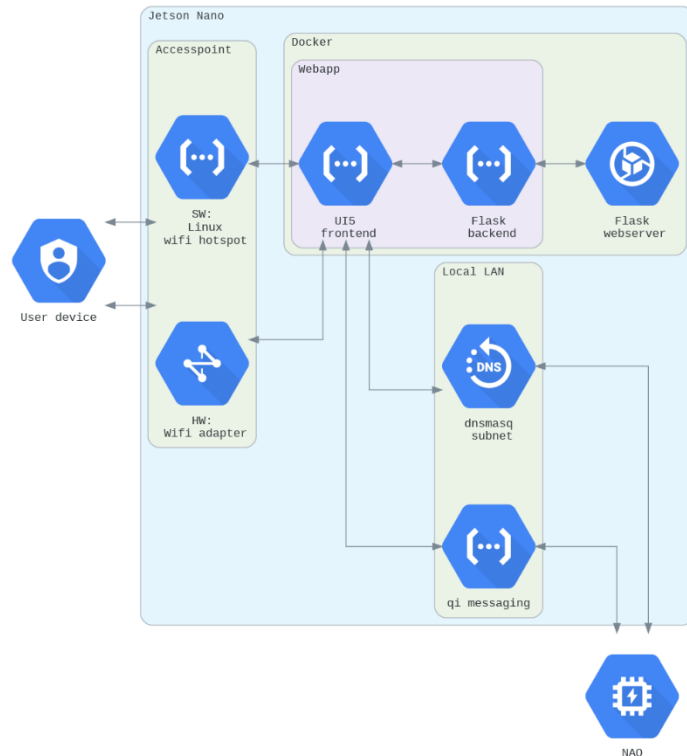
- Battery cover integrated in printed backpack
- Access to all Nano connectors
- Improved heat sink

Nano



- Modern Linux environment
- Overcome NAO hardware limitations
- Onboard power supply in the backpack
- GPU for greater possibilities in computer vision

System architecture



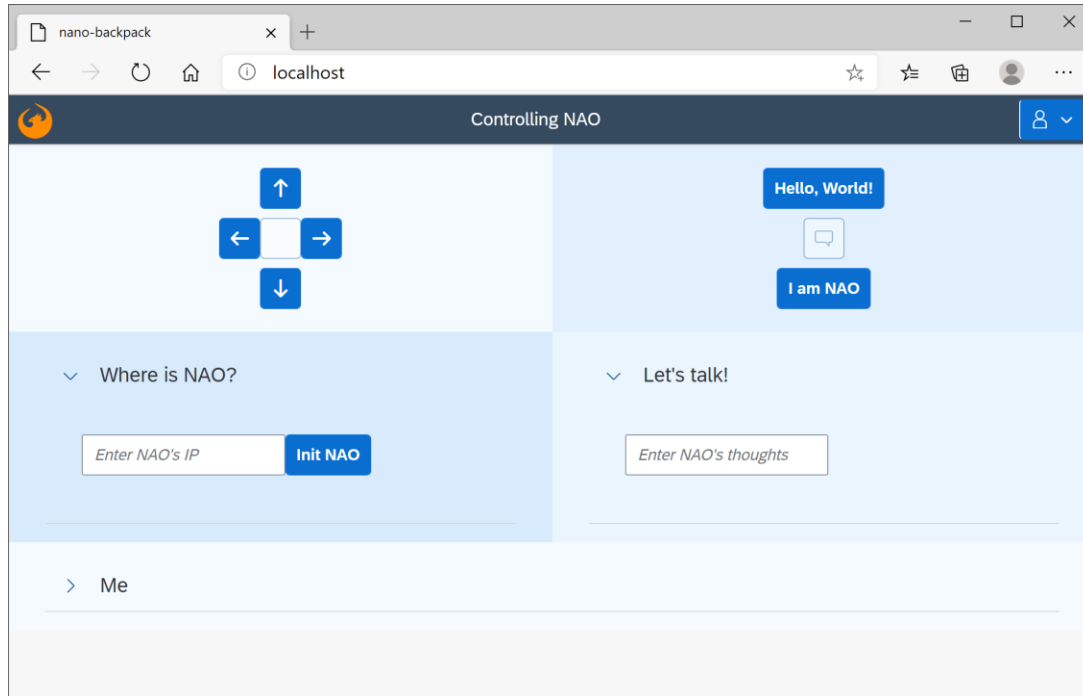
- Access Nano remotely
- Docker container runs web app

Docker

```
PS C:\Users\alexb\Documents\GitHub\nano-backpack\src\app> docker build -t "nano-backpack" .
[+] Building 3.4s (9/9) FINISHED
=> [internal] load .dockerignore 0.0s
=> => transferring context: 2B 0.0s
=> [internal] load build definition from Dockerfile 0.0s
=> => transferring dockerfile: 32B 0.0s
=> [internal] load metadata for docker.io/library/python:3.7 3.3s
=> [1/4] FROM docker.io/library/python:3.7@sha256:024435824a908ba1905e824d53dbb5d967d34e75c3adbbae371fb58e9c57382d 0.0s
=> => resolve docker.io/library/python:3.7@sha256:024435824a908ba1905e824d53dbb5d967d34e75c3adbbae371fb58e9c57382d 0.0s
=> [internal] load build context 0.0s
=> => transferring context: 758B 0.0s
=> CACHED [2/4] RUN pip install flask==1.1.1 && mkdir -p /app/static && wget -c https://github.com/SAP/openui5/releases/download/1.84.0/openui5-runtime-1.84.0.zip && unzip 0.0s
=> CACHED [3/4] COPY . /app/ 0.0s
=> CACHED [4/4] WORKDIR /app 0.0s
=> exporting to image 0.0s
=> => exporting layers 0.0s
=> => writing image sha256:08069635330373e2c2d4a7e43a565afc0f38a59e5559d6de3a21f3d435b51f05 0.0s
=> => naming to docker.io/library/nano-backpack 0.0s
PS C:\Users\alexb\Documents\GitHub\nano-backpack\src\app> docker run --rm -it -p 80:80 nano-backpack
* Serving Flask app "app" (lazy loading)
* Environment: production
  WARNING: This is a development server. Do not use it in a production deployment.
  Use a production WSGI server instead.
* Debug mode: on
* Running on http://0.0.0.0:80/ (Press CTRL+C to quit)
* Restarting with stat
* Debugger is active!
* Debugger PIN: 306-270-198
```

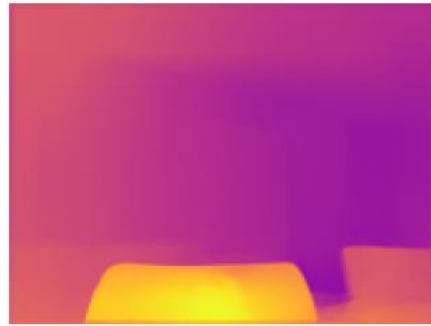
- Caching → build in few seconds, no internet access required

Webapp



- UI5 front-end (JS)
- Flask back-end (Python)
- See video

Depth estimation in video stream



- Custom dataclass to handle video input
- Can later be combined with *ALVideoDevice* of the NAOqi-API

Benefits

1. Overcome previous hardware limitations
2. Easy start with step-by-step instructions
3. Reuse, modify, extend webapp and Docker image
4. State-of-the-art development environment
5. Ready-to-use depth estimation in video stream