Robust and Repairable vital signs Monitoring for Mobile Hospital Boxes

Medical Devices for All

Dagmar Krefting, Sebastian Jünemann and the remo2hbo-Team

Emergency Response in a changing world

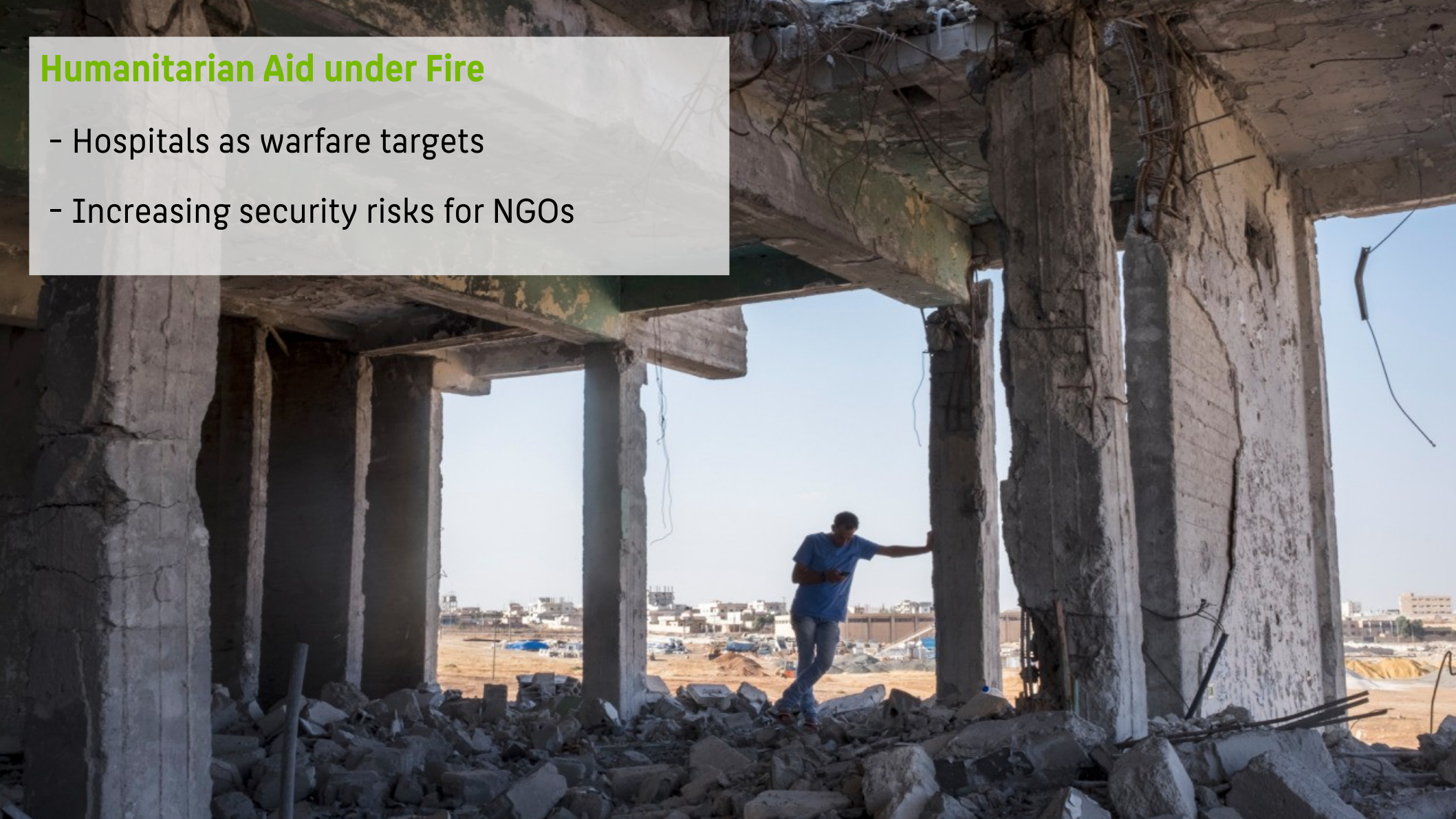
- Climate Change
- Armed Conflicts

Traditional Humanitarian Actors

- Governmental Organizations
- Large international NGOs

Humanitarian Aid under Fire

- Hospitals as warfare targets
- Increasing security risks for NGOs



Small and local NGOs

- faster and less bureaucratic
- flexible response to local needs

Small and local NGOs

- help where the large NGOs are not present

- stay when media interest decreases

Specific requirements for small NGOs

- less infrastructure to rely on

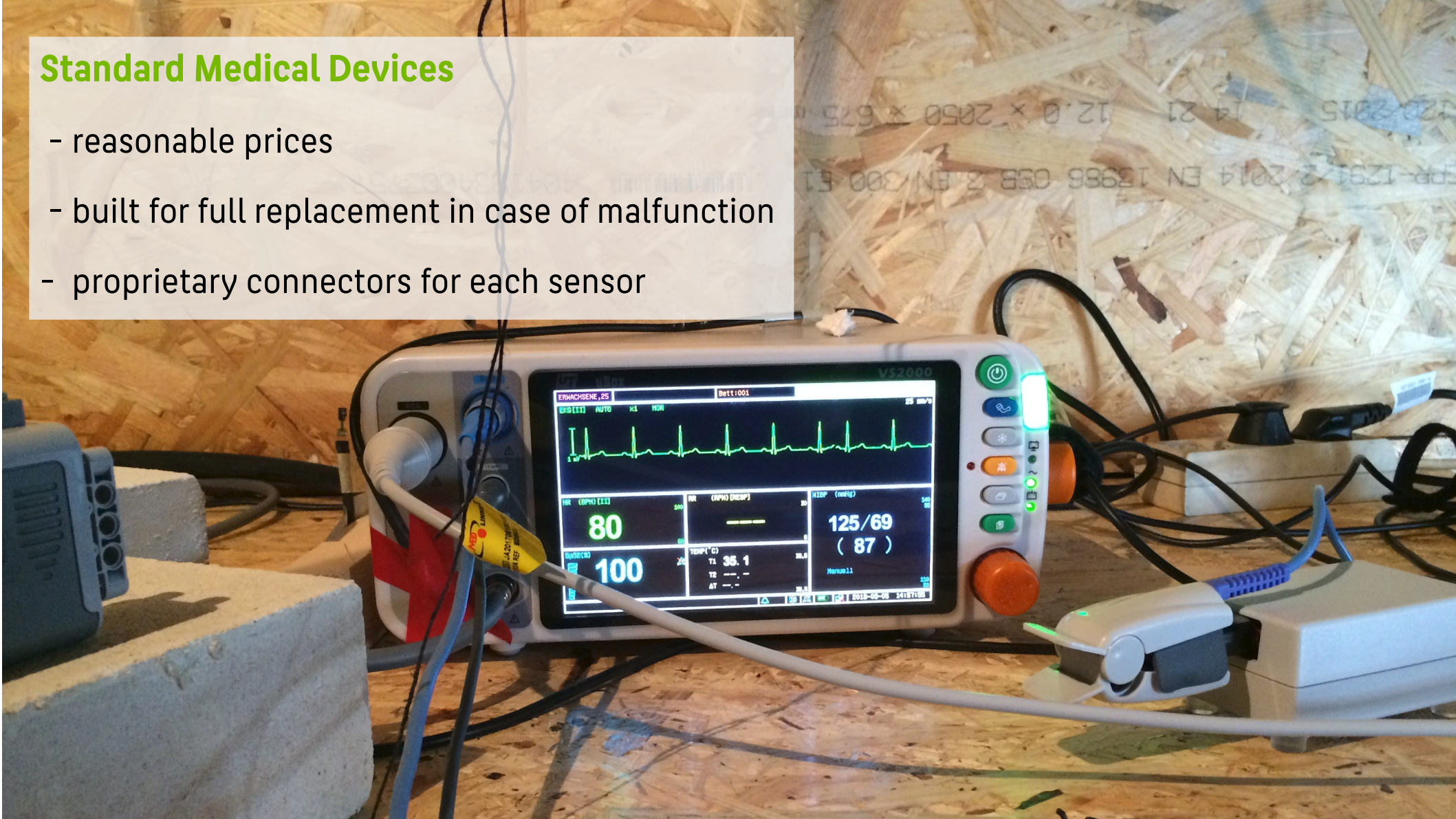
- less financial capabilities

Example Mobile Hospital

- built and equipped by German NGO
- handed over to local NGO in Rojava

Standard Medical Devices

- reasonable prices
- built for full replacement in case of malfunction
- proprietary connectors for each sensor



Mobile Medical Devices

- special robust versions exist – neither repairable
- very expensive - not affordable for small NGOs

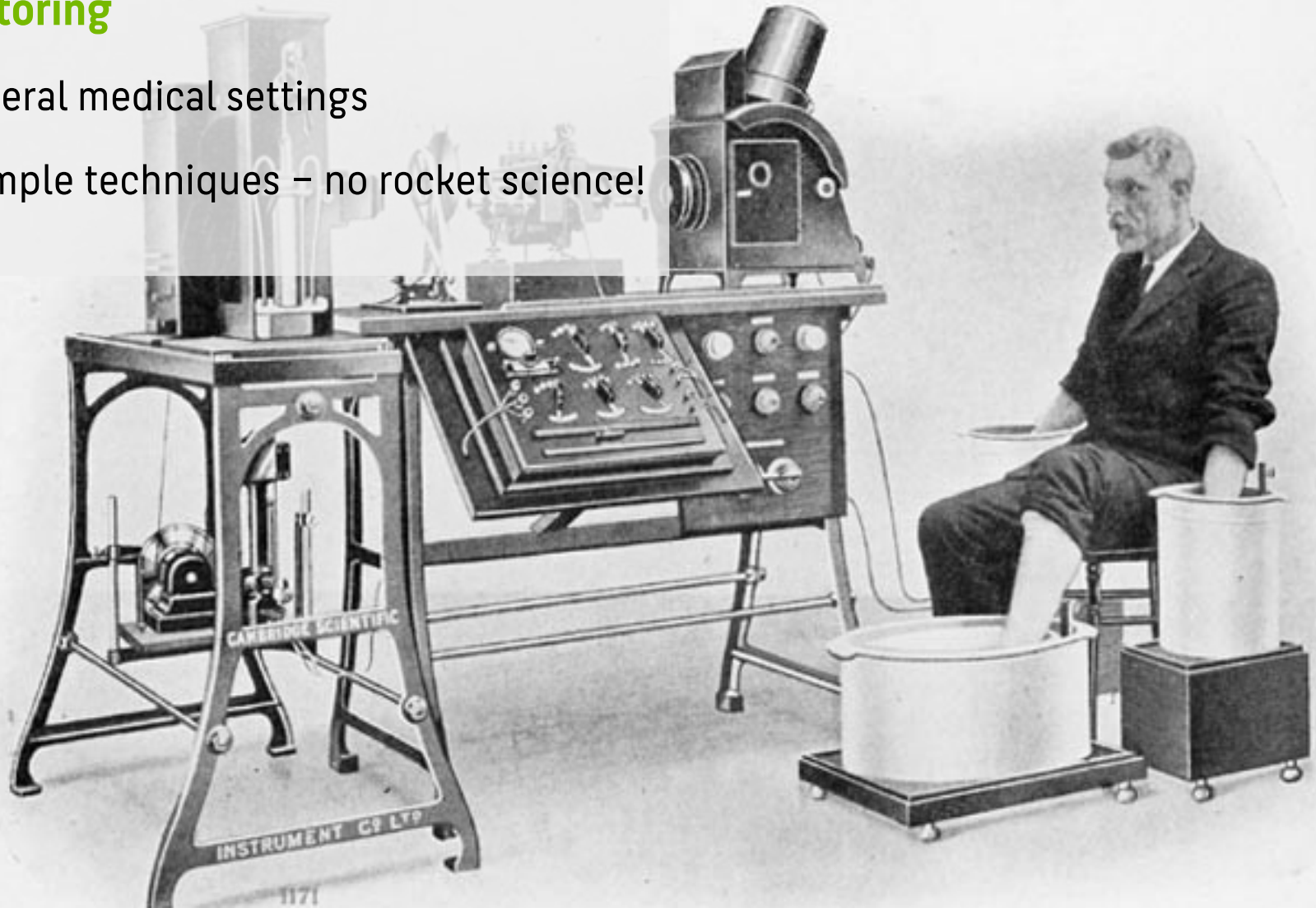
Remo2hbo approach

- robust against heat, dust and shocks
- repairable for non-experts with standard tools
- affordable and producible for everyone

Vital sign monitoring

- required in several medical settings

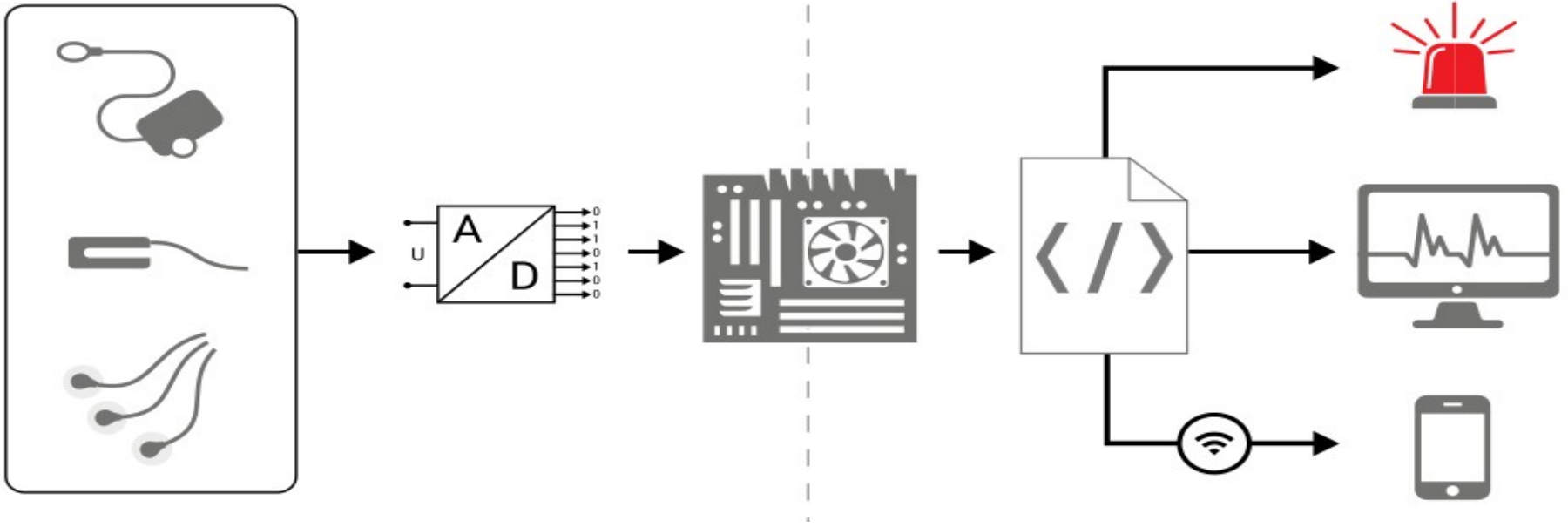
- comparably simple techniques – no rocket science!



Vital sign monitoring

- generic architectural layout

- hard- and software open source and free

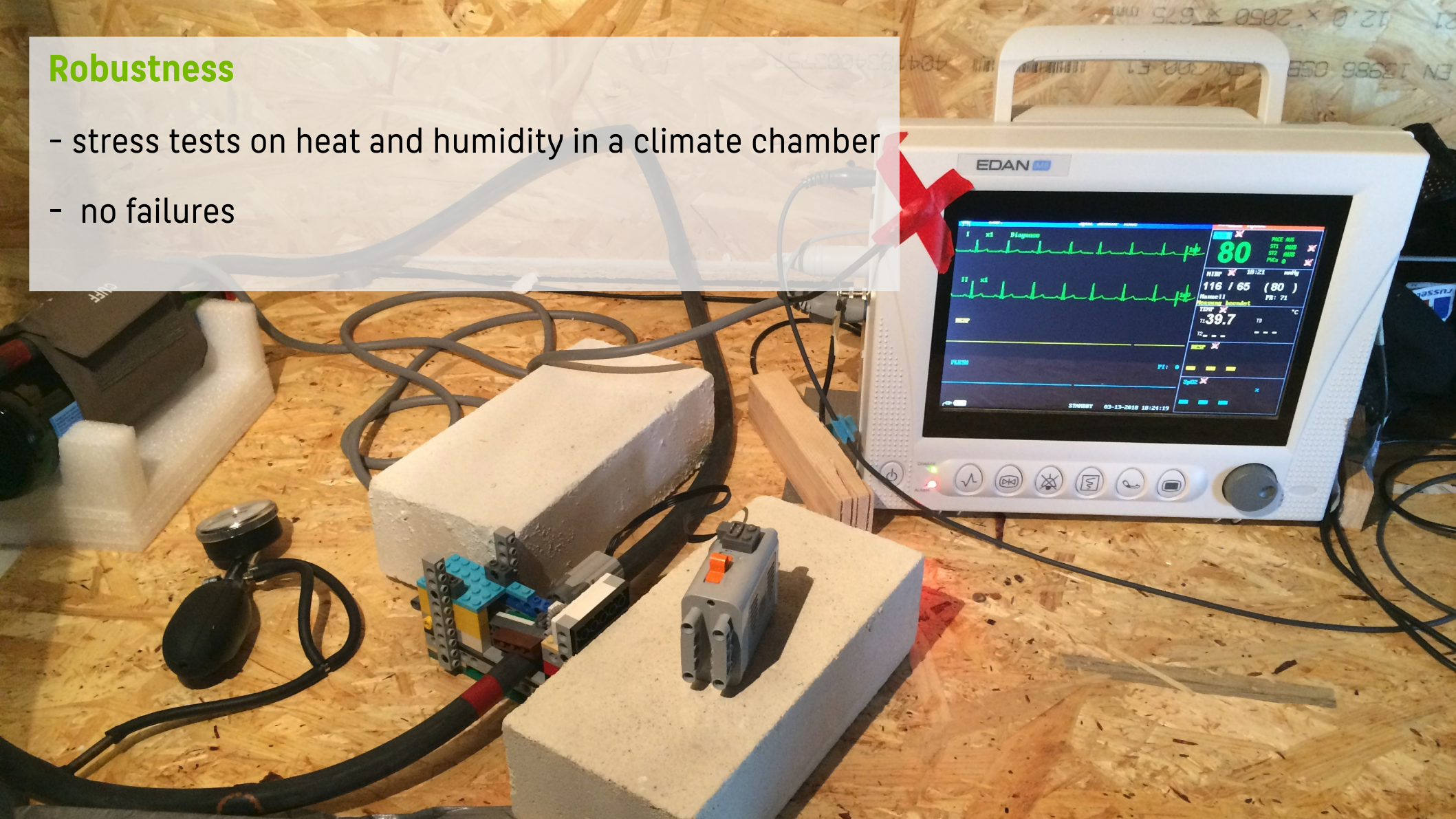


The team

- computer sciences, emergency response,
- medical physics, engineering

Robustness

- stress tests on heat and humidity in a climate chamber
- no failures



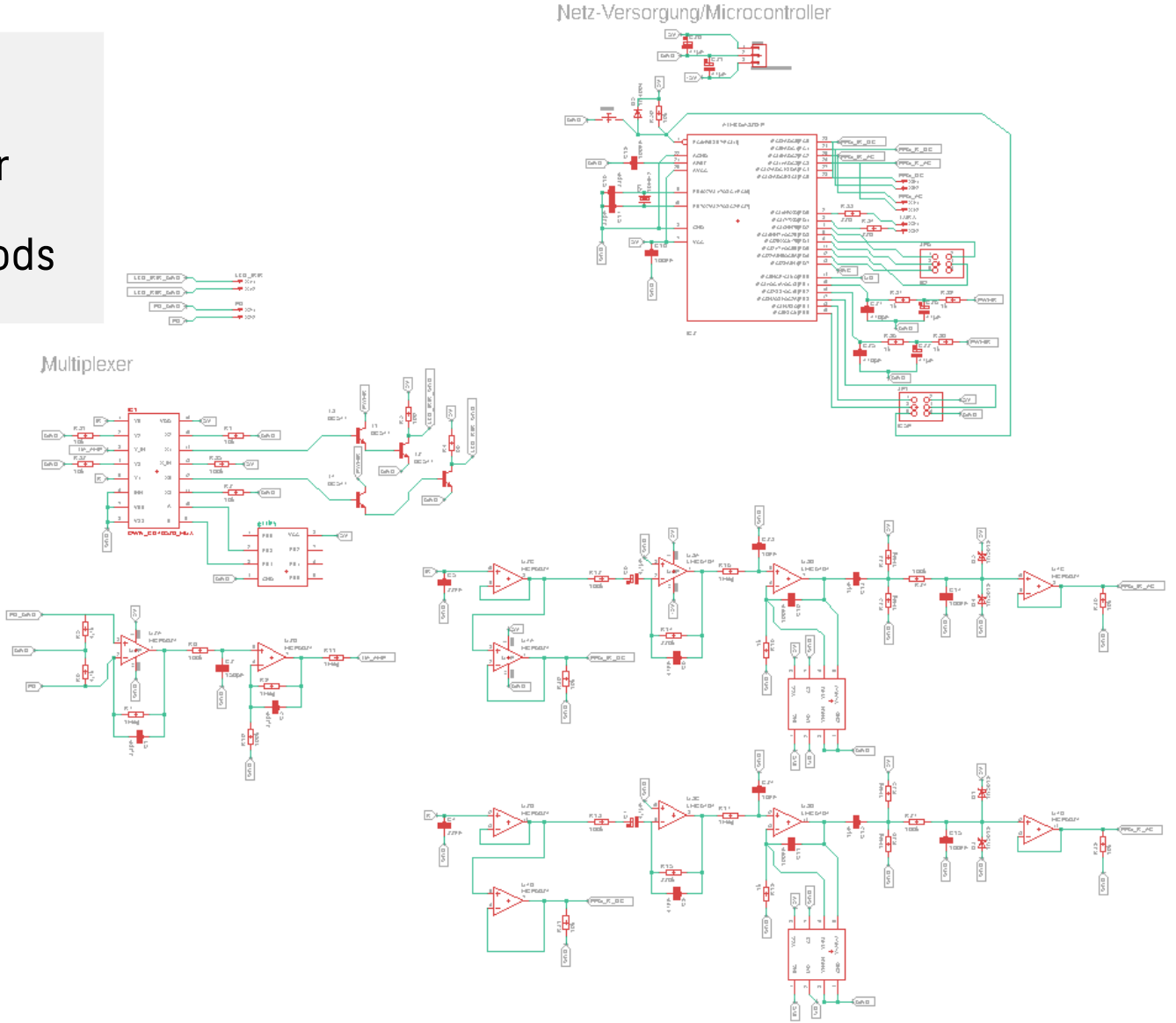
Robustness

- stress tests in a dust chamber
- weak point of standard devices

Sensor hardware

- Temperature – standard sensor

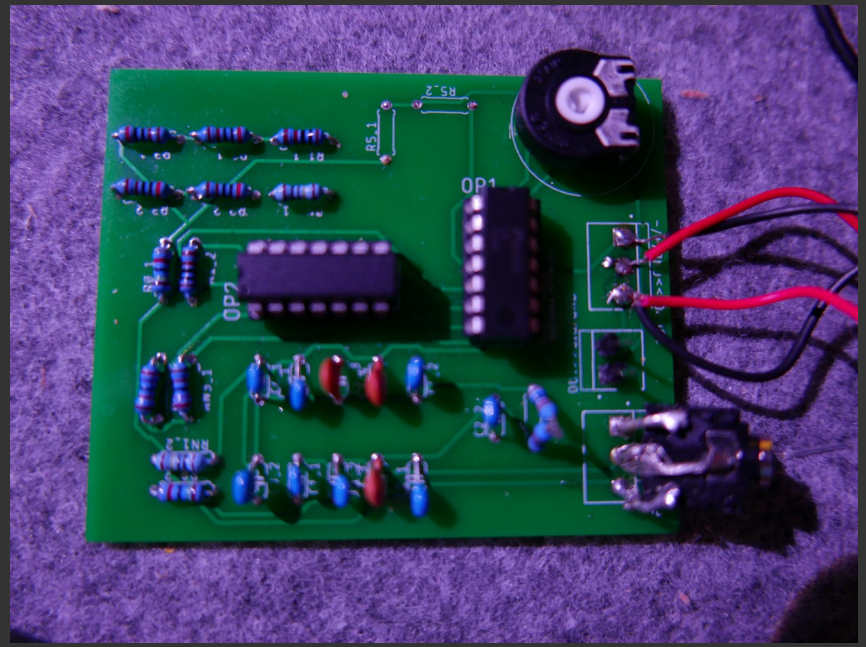
- ECG and SO2 – standard methods

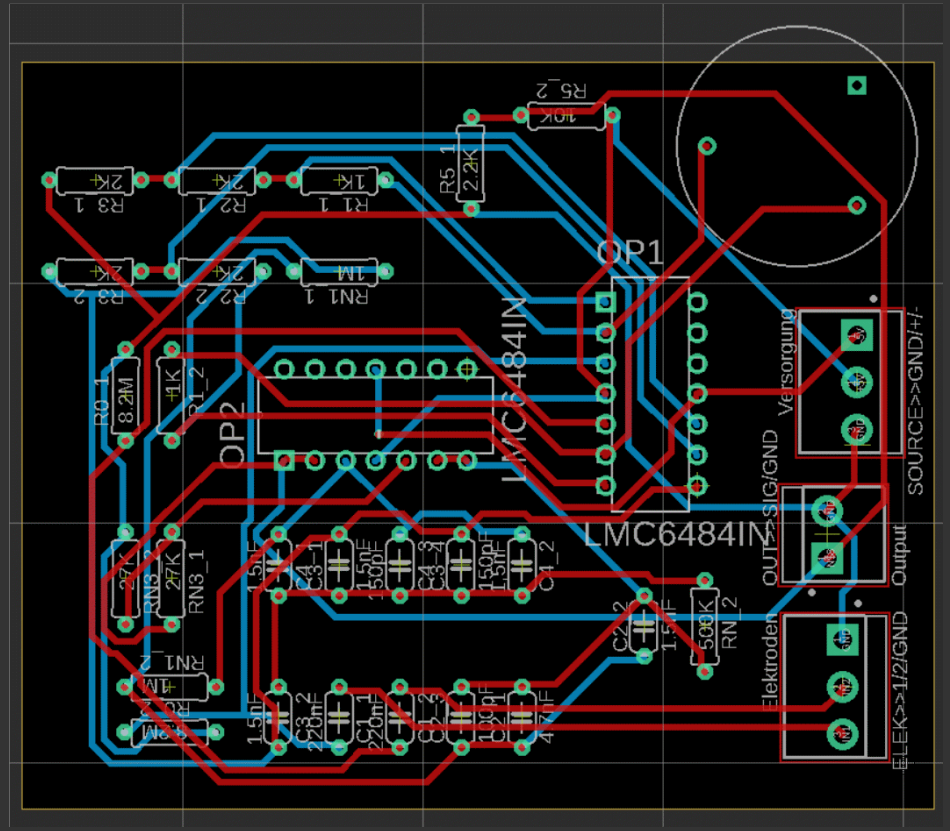


Sensor hardware

- Temperature – standard sensor

- ECG and SO2 – standard methods

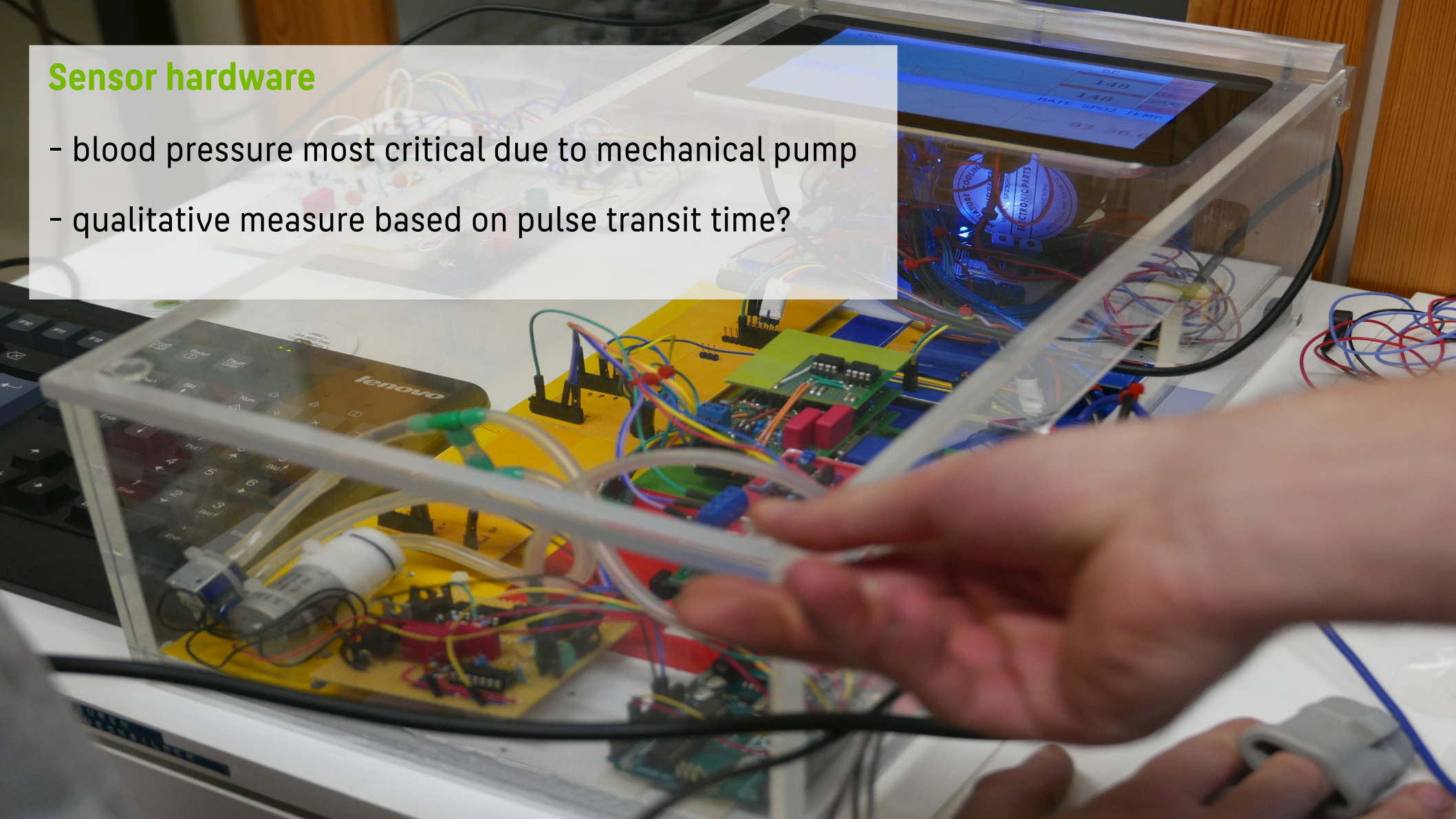


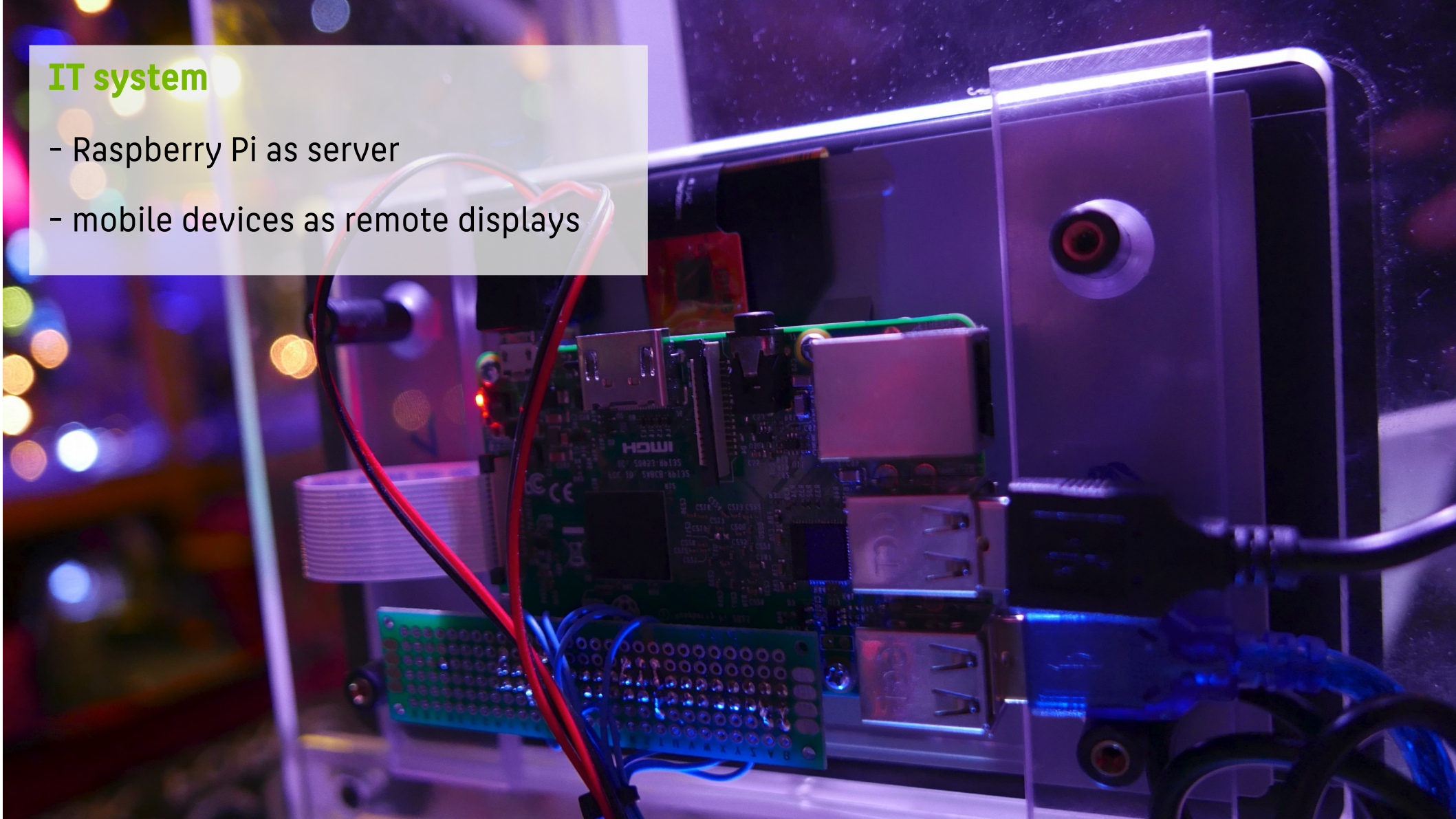


Sensor hardware

- blood pressure most critical due to mechanical pump

- qualitative measure based on pulse transit time?



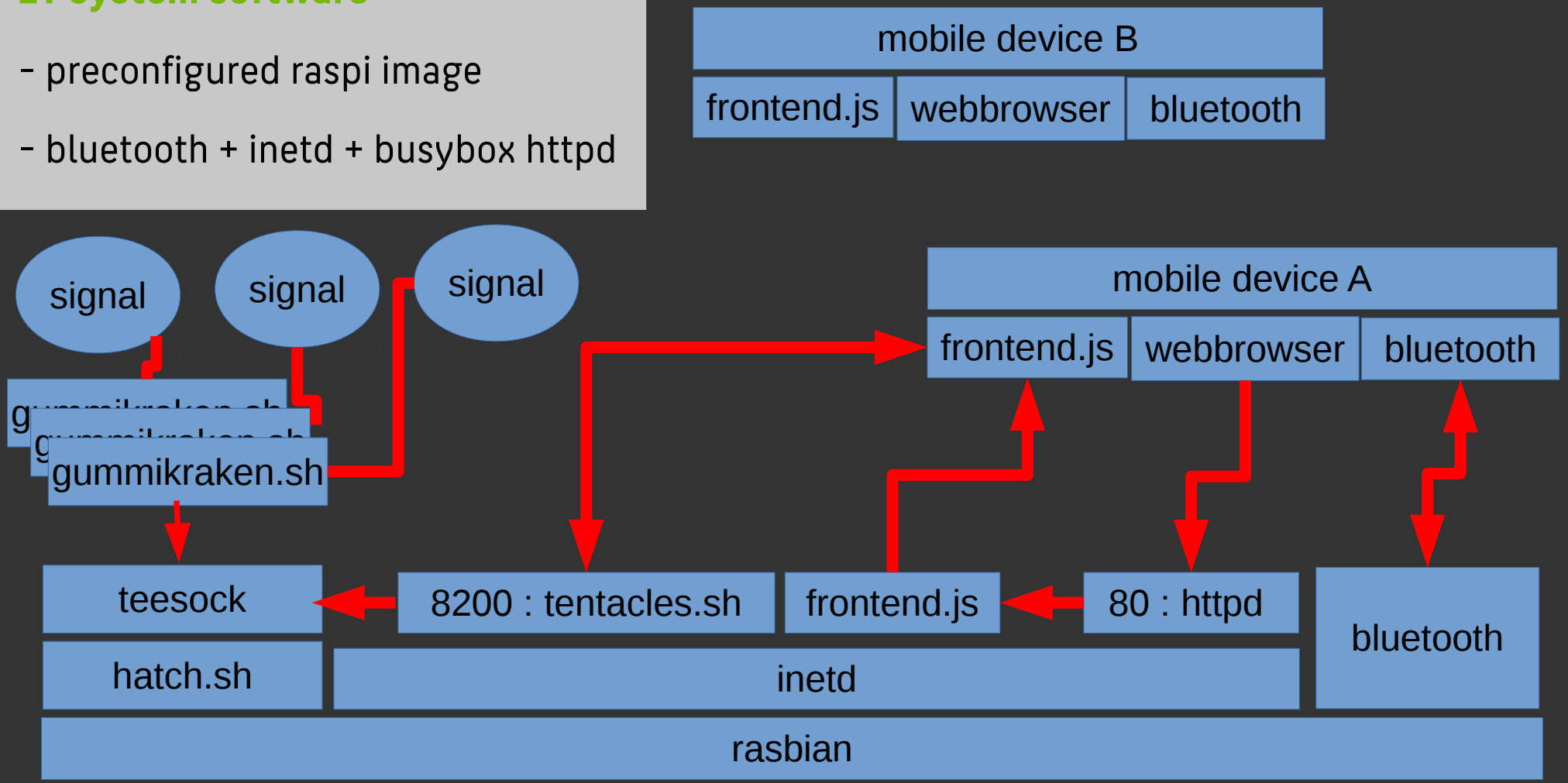


IT system

- Raspberry Pi as server
- mobile devices as remote displays

IT system software

- preconfigured raspi image
- bluetooth + inetd + busybox httpd

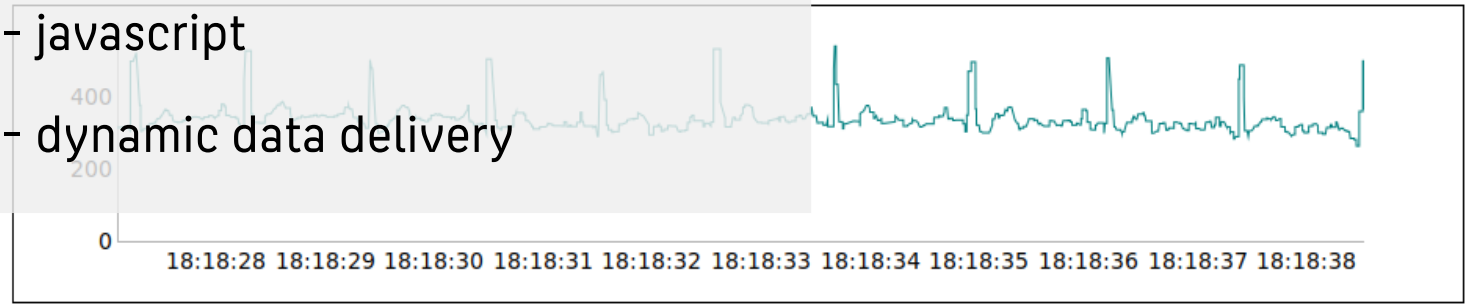


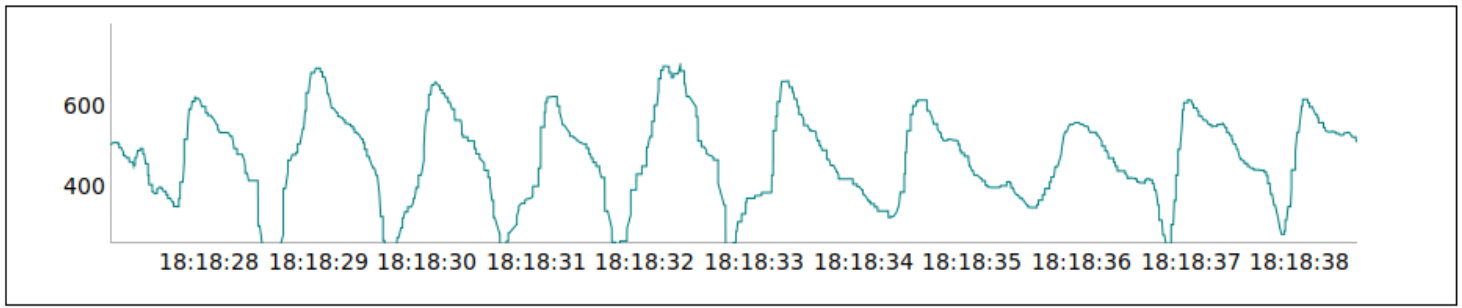
Hotspot Login
http://nmcheck.gnome.org/

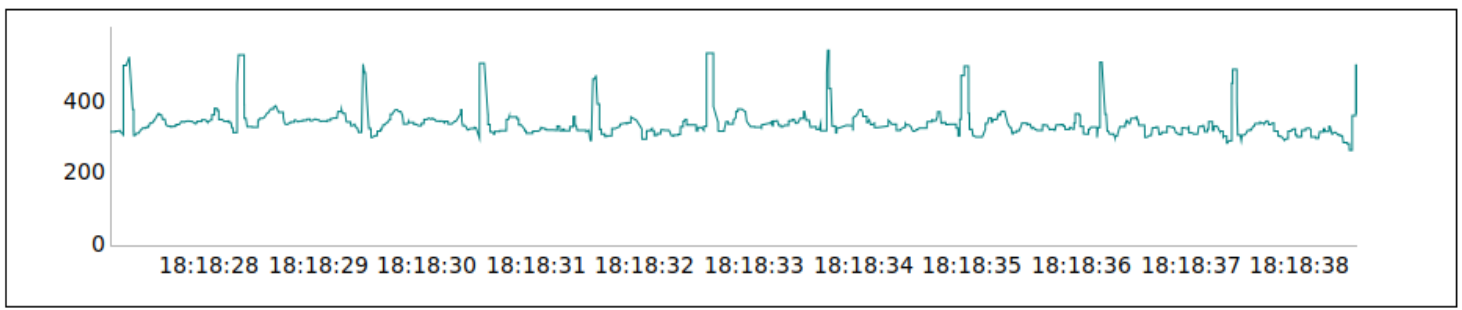
OKTOPUS BIOSIGNAL MONITORING

IT system frontend

- javascript
- dynamic data delivery







°C
365

HR
0

sO2
95

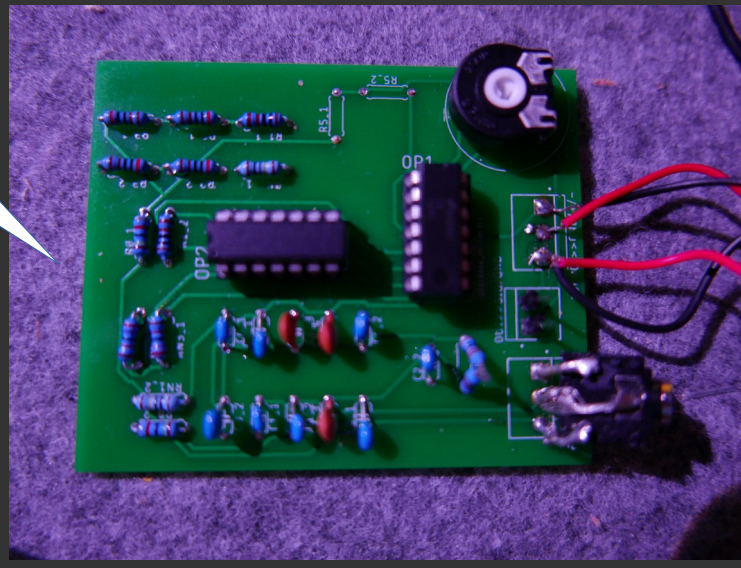
RR
148 / 148

status: connected.

Financial Summary

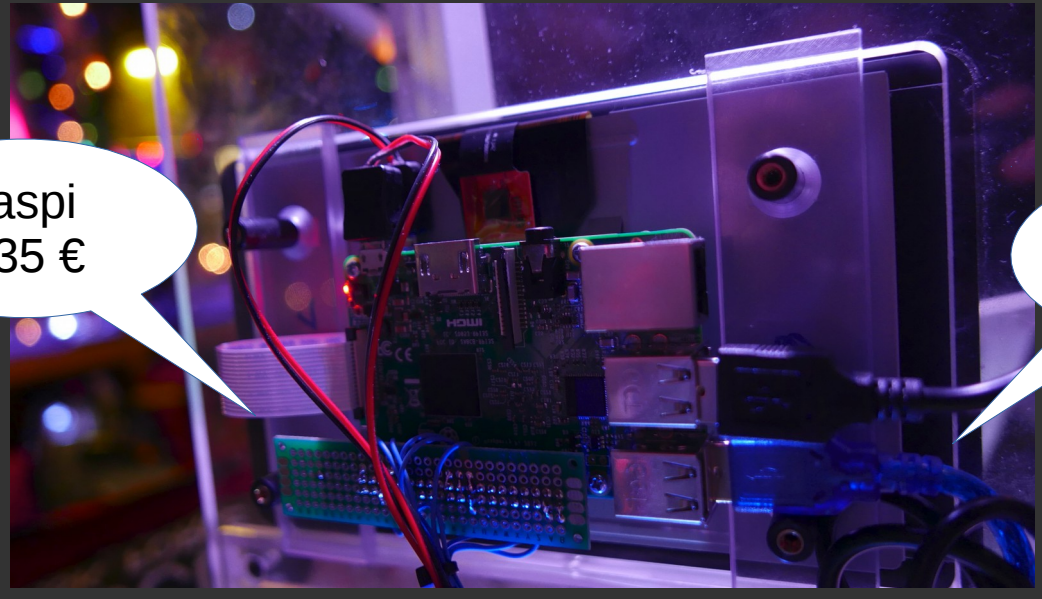
- signal hardware: < 100 €
- IT system hardware: ~100 €
- mobile devices

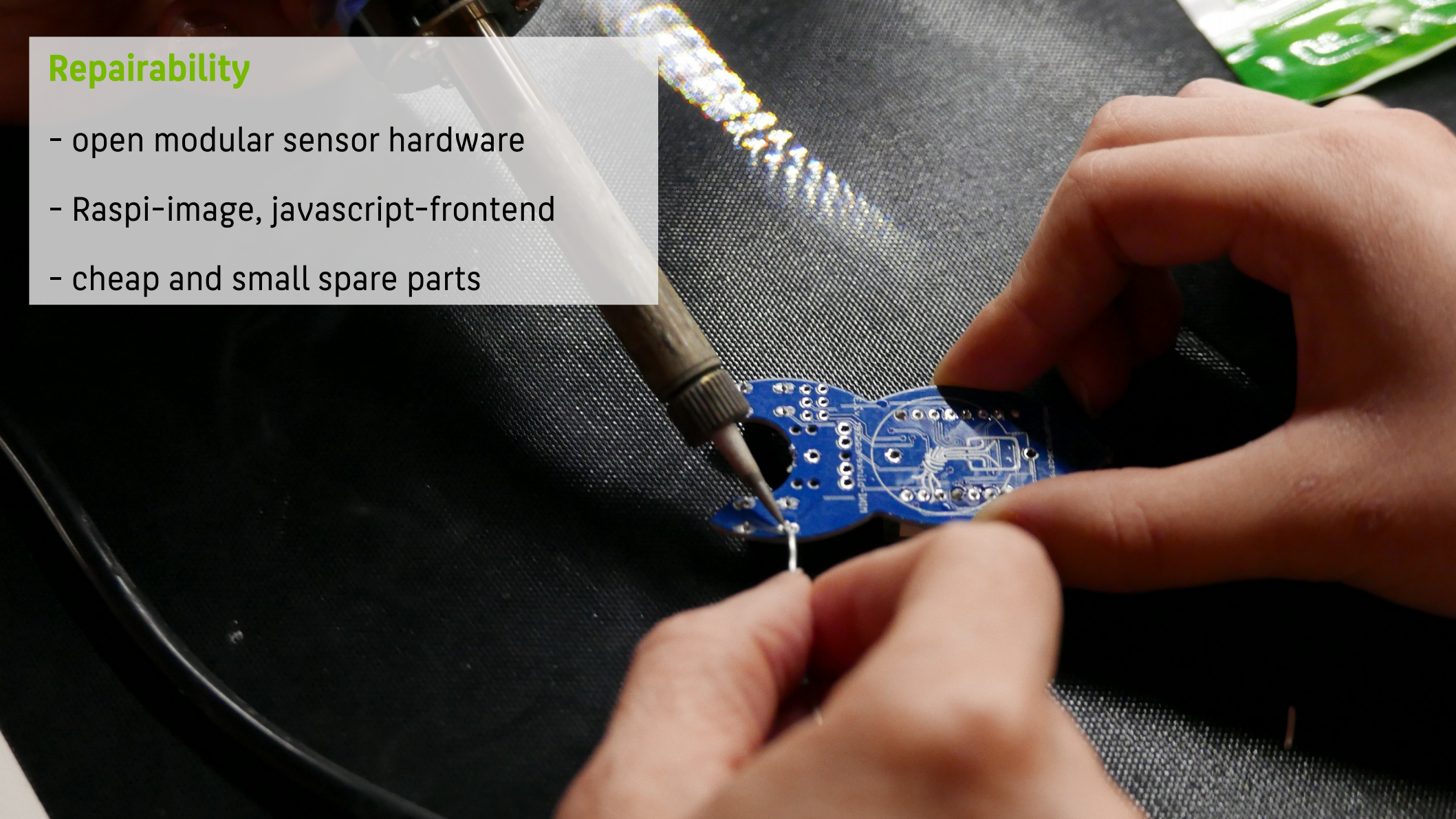
ecg-system
12 €



raspi
~35 €

display
~70 €





Repairability

- open modular sensor hardware
- Raspi-image, javascript-frontend
- cheap and small spare parts

Help needed – Get involved
- Test
- Compare
- Improve
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