CWI Centrum Wiskunde & Informatica

iotsa - an architecture for wireless sensors and actuators

Jack Jansen
Centrum Wiskunde & Informatica
Jack.Jansen@cwi.nl

What is it?

- Internet-Of-Things Server Architecture
- Combined Hardware and Software
  - Easy-to-modify hardware
  - Arduino-like software
  - WiFi
  - Cheap

Example Devices

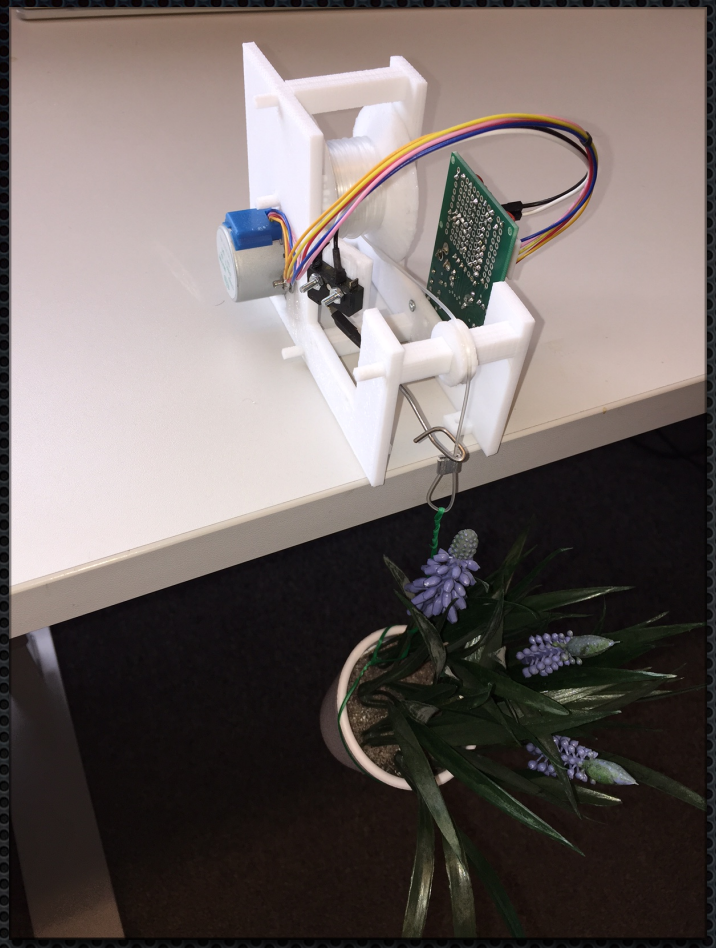
NeoClock - a clock that can show alerts

CWI Centrum Wiskunde & Informatica

Example Devices

DoorOpener - Open door with RFID

CWI Centrum Wiskunde & Informatica



Example Devices

Plant - move an object up and down

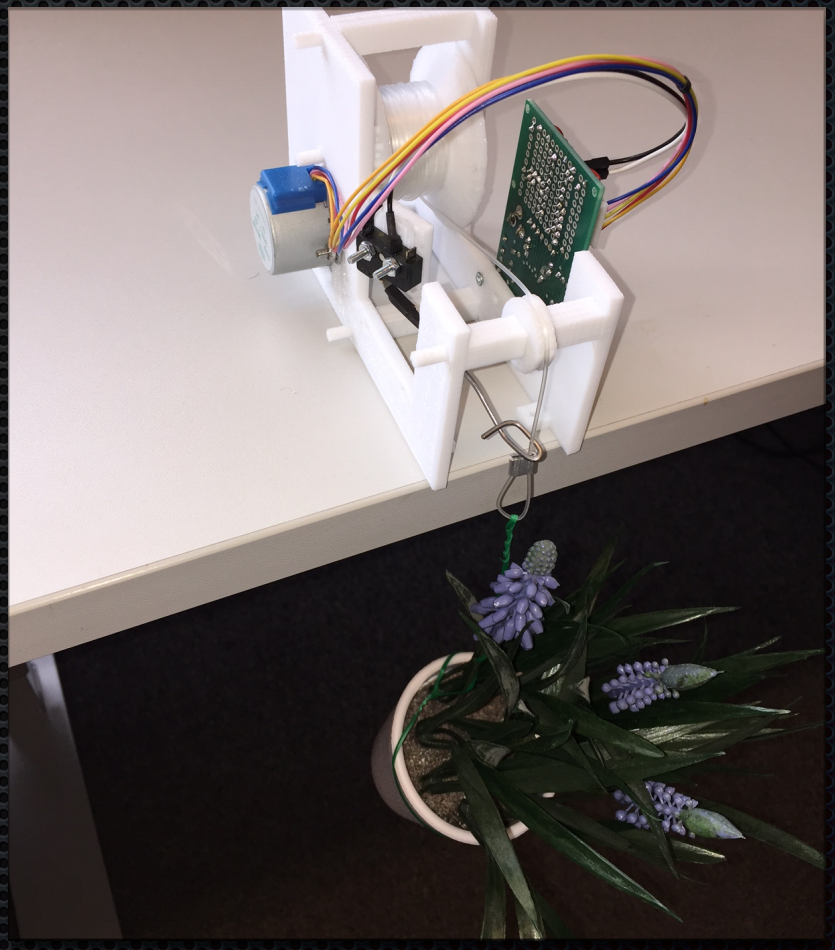
CWI Centrum Wiskunde & Informatica

From Idea to Deployment

- Open Hardware
- Open Software
- See https://github.com/cwi-dis/iotsa
- This example: https://github.com/cwi-dis/iotsaMotorServer

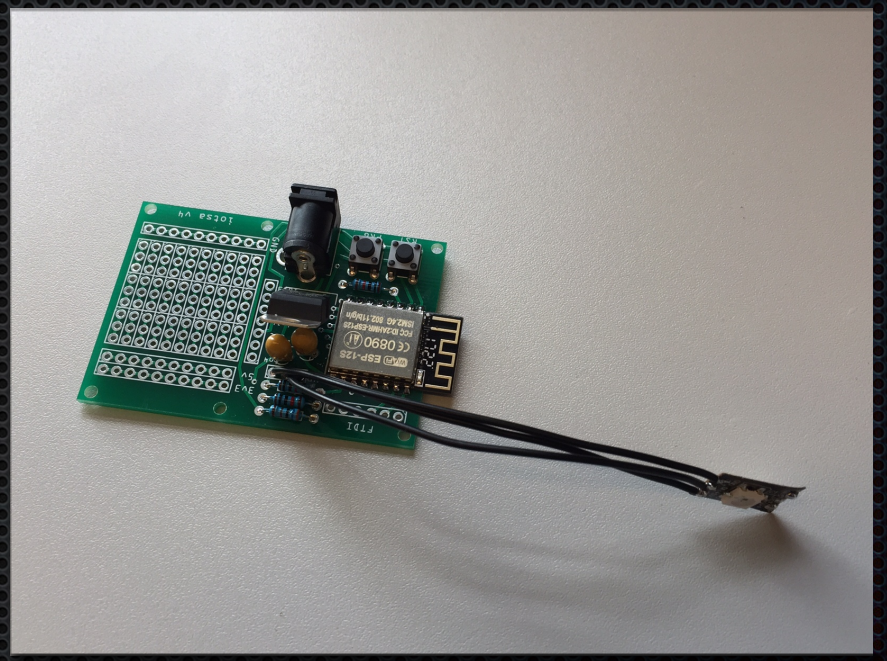
The idea

Wouldn't it be cool to have a potted plant move up and down under program control...



The iotsa Board

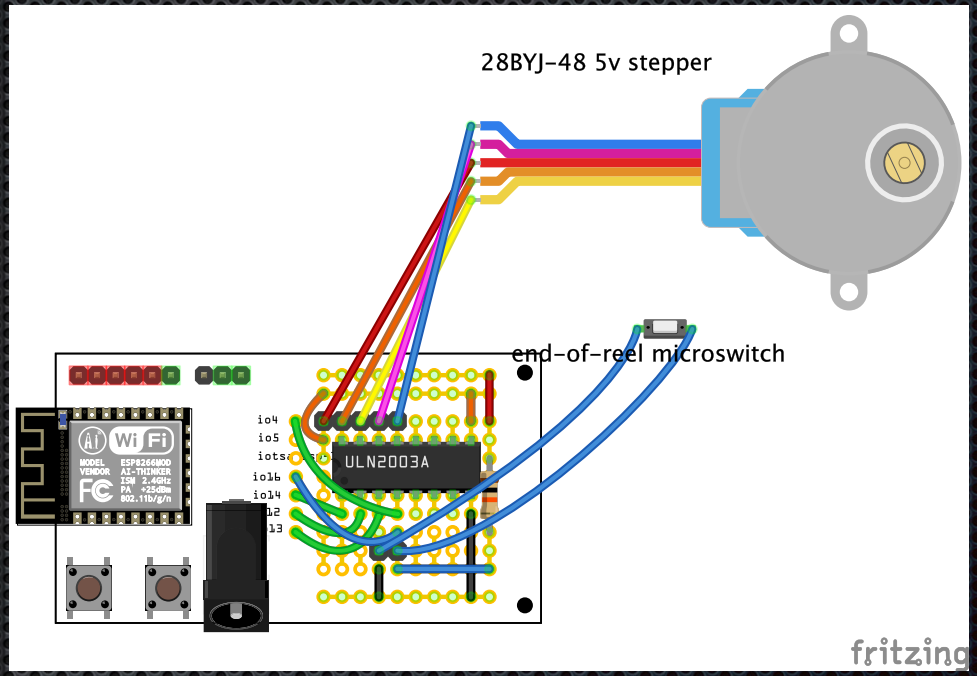
- Esp8266 CPU, WiFi
- Power supply
- Experimentation area
- Optional multicolor LED



CWI Centrum Wiskunde & Informatica

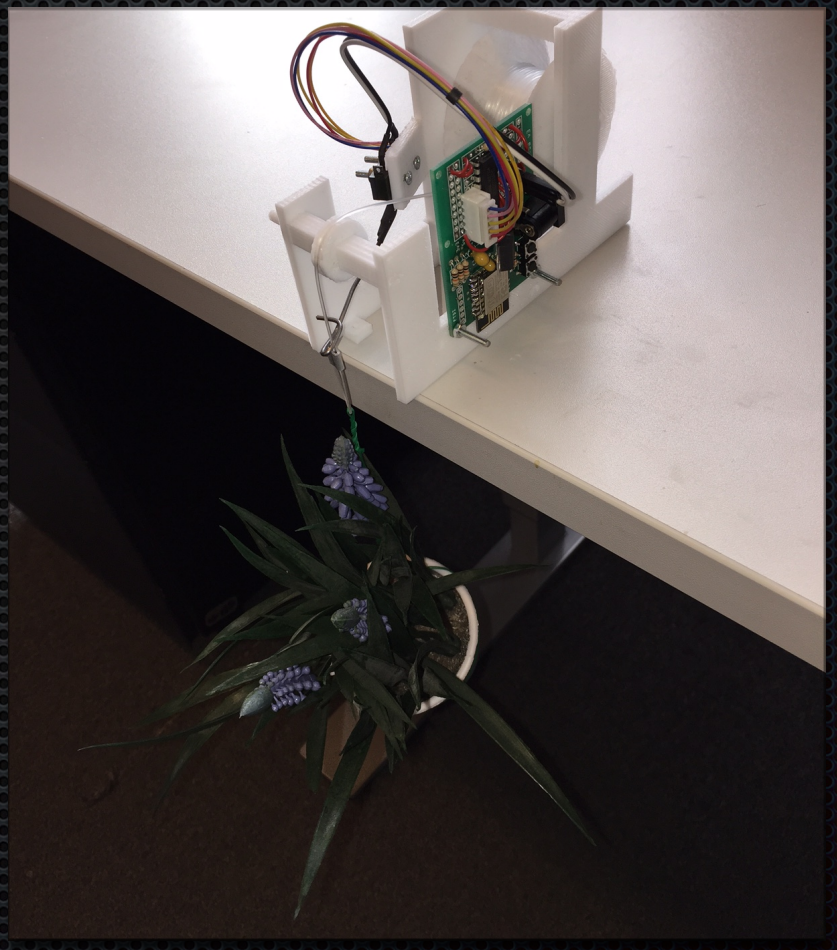
Hardware design

Electronics,
Mechanics,
Interaction,
Housing



CWI Centrum Wiskunde & Informatica

Hardware construction



Soldering, 3D-printing, Assembly

Device Software

- Uses standard Arduino IDE
- Familiar *setup()* and *loop()* paradigm
  - Initialize stepper hardware
  - Move to required position
- Add *handler()* method to control required position
- Select iotsa optional modules:
  - time sync, OTA programming, username/passwd, ...

Host Software

- Access URL http://plant.local/stepper/0?pos=400
  - Moves plant to 400mm below top position
- Status: http://plant.local/stepper/0
  - {"id":"0", "pos":470, "target":500, "speed":2.92, "inrange":1}

Host Software - 2

- Any programming language with web access
- Python, node.js, Processing, shell script, ...

```
>>> import urllib
>>> urllib.urlopen("http://m369plant.local/stepper/0?pos=200")
```

- Anywhere on the local network
  - No wires, no cloud

Igor Integration

- Sensor: iotsa reading electricity use from dutch smart meter
- Actuator: iotsa plant mover
- Igor: moves plant to height that reflect current electricity use

Deployment

- Install new iotsa application over-the-air from Arduino IDE
  - Or use USB with FTDI if board has been bricked
- Fresh device creates private WiFi
- End user connects, enters WiFi name and password
- Device is now online

Deployment - 2

- Dangerous operations require 2-phase process
  - First request operation over WiFi
  - Then power cycle device within 2-minute window
- OTA programming, Changing WiFi parameters, Changing username/password
  - Creator decides

Pros and Cons

- Local REST service, no cloud
  - \+ Privacy, independence
  - – Remote access is difficult
- WiFi
  - \+ Easy integration, no special hardware
  - – Cannot run off batteries
- State-based, not event-based or streaming
  - ± Good for some things, not others

Future Plans

- Need someone to market the NeoClock:-)
- Better UI for web interface, deployment app for phones
- Investigate Bluetooth LE, mixed-mode WiFi/BLE
  - Low power, maybe even coin cells?
- Investigate streaming events
  - And recording for later playback

➡ Synthesis with our work in sensing

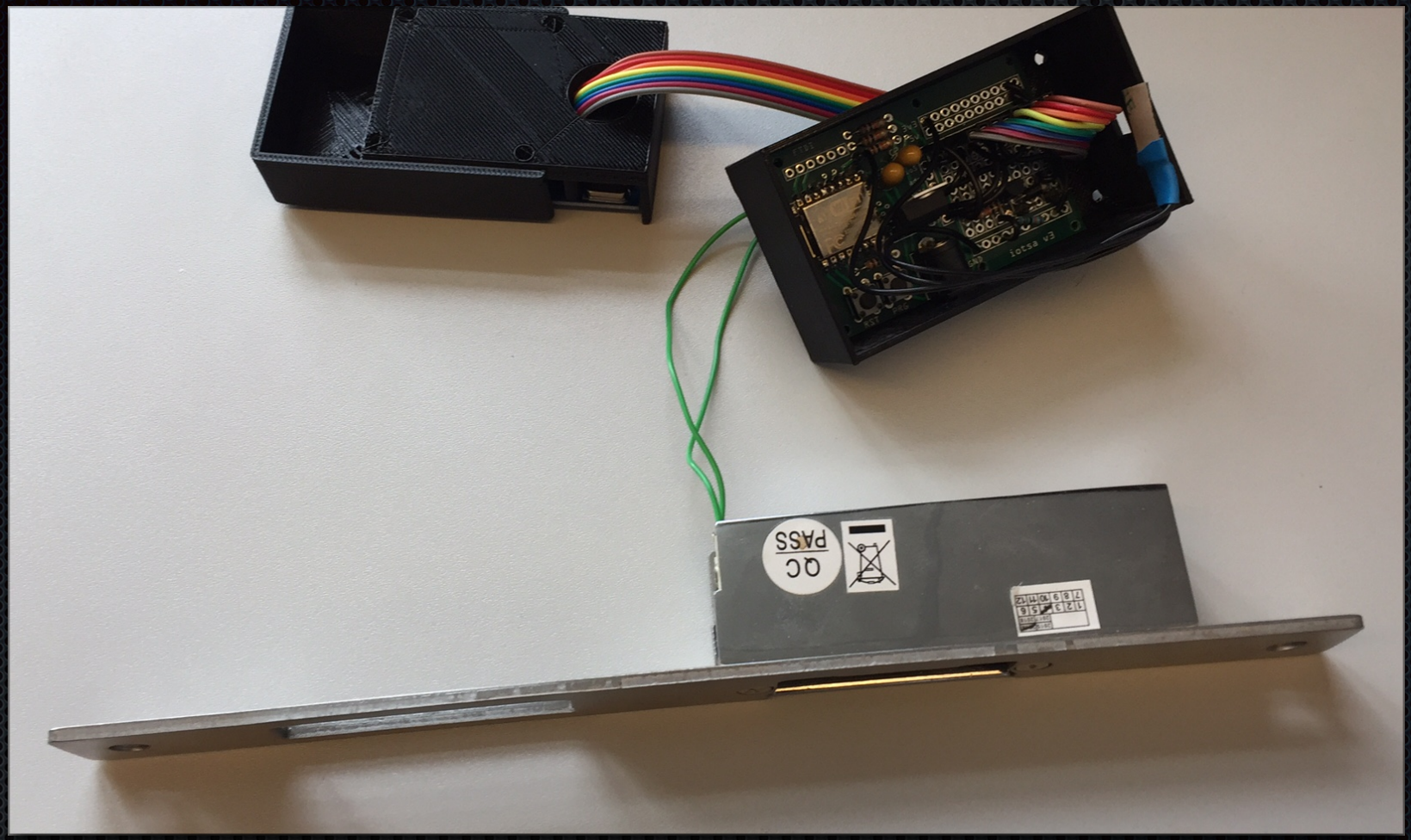
CWI Centrum Wiskunde & Informatica

Thanks!

- https://github.com/cwi-dis/iotsa
- Jack.Jansen@cwi.nl

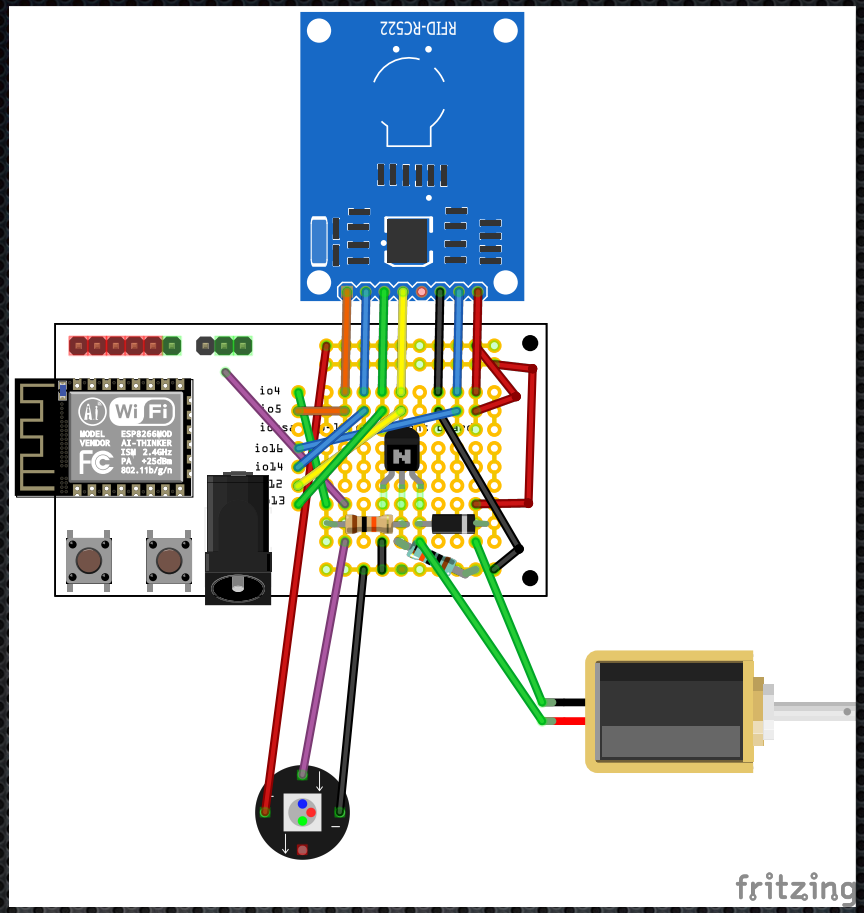
Spare Slides

CWI Centrum Wiskunde & Informatica



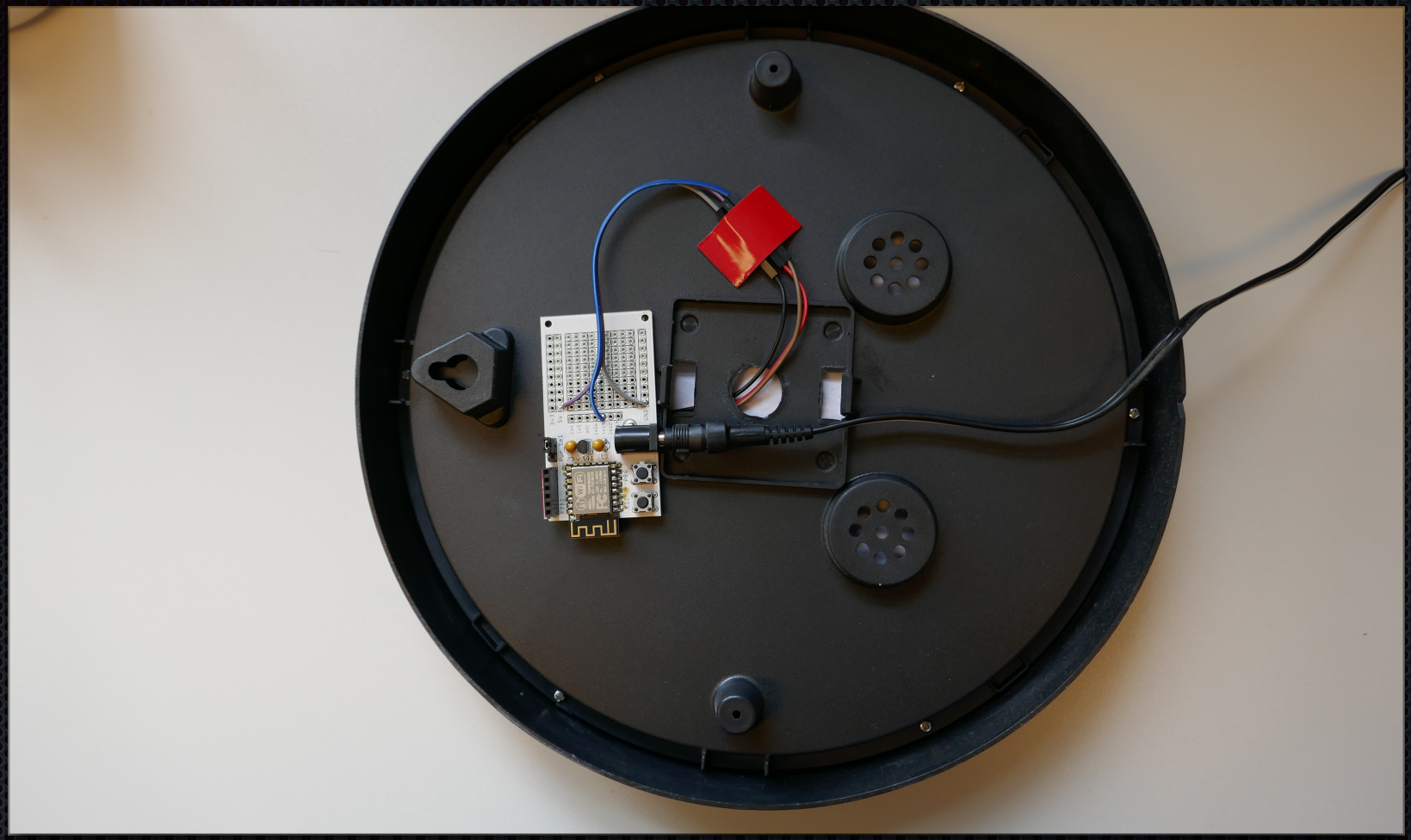
DoorOpener Hardware

CWI Centrum Wiskunde & Informatica



DoorOpener Hardware

CWI Centrum Wiskunde & Informatica



NeoClock Hardware