iotsa - an architecture for wireless sensors and actuators

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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
Example Devices
DoorOpener - Open door with RFID
Example Devices

Plant - move an object up and down
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
Hardware design

Electronics, Mechanics, Interaction, Housing
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`

```json
{"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, ...
  ```python
  >>> 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
Thanks!

- [https://github.com/cwi-dis/iotsa](https://github.com/cwi-dis/iotsa)
- [Jack.Jansen@cwi.nl](mailto:Jack.Jansen@cwi.nl)
DoorOpener Hardware
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NeoClock Hardware