Web of Twins?

Walking through a "privacy by design" chain from sensor's microcontroller to XR

#WotWs2 Munich, Germany <2019-06-04>

Philippe Coval
Samsung Open Source Group / SRUK
pcoval@samsung.com

$ who is Philippe Coval

Samsung Open Source Group

- Software engineer for **Samsung OSG**
  - Belongs to SRUK team, based in Rennes, France
  - Interest: **Web of Things** with “Privacy by Design”
  - Contributor: Tizen, IoTivity, Mozilla WebThings, IoT.js, TizenRT...
  - Multi-active: FLOSS, OSHW, IoT, Web, 3D/XR, Communities
- Ping me online:
  - https://social.samsunginter.net/@rzr

Digital Twins

What are digital twins ?

SAMSUNG
Open Source Group

- Introduced by Dr M. Grieves (FIT)
  - Context: 2002 as part of PLM, NASA
- Real time (or deferred) connectivity:
  - Between the **physical component**
    - and its **digital counterpart**
- “Devices as service” concept:
  - Applies to many industry:
    - City, manufacturing, health, transport…
    - Near “Real Time” data ?

- Useful for:
  - Re/Co/Design
  - Monitoring, Quality tracking
  - Impact analysis:
    - Dependency, process, lifecycle, financial...
  - Digital traces for analytic
  - Simulation, AI/ML etc
  - **Improve decision making**

Digital twins are model driven, use cases:

Samsung
Open Source Group

- Smart Factory
  - A Reference model of product
    - is versioned
  - Some property of model is changed
    - By design team, suppliers
    - Or even end consumer?
  - Simulation checks and validation
  - Production is reconfigured
    - CNC machines updated
  - A new batch of product is effective

- Smart City
  - Observe environment, traffic, energy...
    - Simulate new strategies, paths
    - Apply changes:
      - Smart buildings, IoT
      - Recommendation, Social Web...
  - Model is evolving in real time
    - Observe global effects
  - Citizen to be involved if public
    - Could adjust their SmartHome devices
      - Heat, Air Quality → Ventilation
    - Privacy should be preserved

Proof of concept

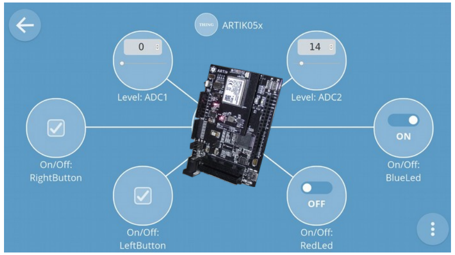
Ethic considerations & challenges

- FLOSS + Open Standards
  - Accessible & Inter operability:
  - Stable API and semantics needed
- **Privacy by design**
  - Comply to GDPR Article 25
- Transversal
  - On the Web!
  - With the web (Eg: OpenData sources)
  - CAD Model in browser
  - Microcontollers nodes (IoT.js)

- Using Mozilla WebThing platform:
  - User generated data
    - stay home by default
  - **Decentralized** & Access Control
    - Resources can be shared:
      - JSON Web Token
    - Optional Remote access
- Scalability?
  - Hosting & Versioning?

Javascript the language of Web (of Twins)

- **IoT.js** an alternative runtime inspired by Node.js:
  - Powered by JerryScript engine designed for micro-controllers
  - Base features: IO (I2C, GPIO...), Network (HTTP/S, MQTT, WS) ...
    - Modules: iotjs-express, mastodon-lite, generic-sensors-lite
  - Supporting: TIZEN *RT*, GNU/Linux ...
- WebThings can be build using **webthing-iotjs** module:
  - Standalone HTTP servers exposing **Mozilla Things API**:
    - RESTful architecture: read, update operations
  - Can be connected to MozIoT “PrivacyByDesign” gateway



ARTIK05x

0
Level: ADC1

14
Level: ADC2

On/Off: RightButton

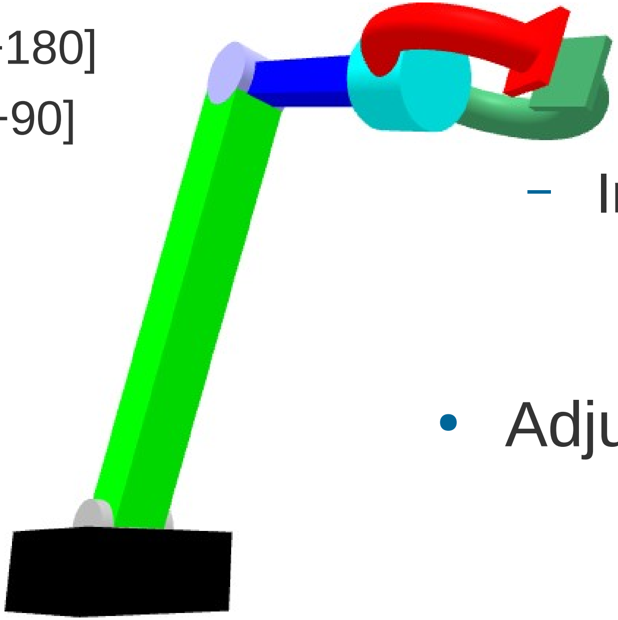
ON
On/Off: BlueLed

On/Off: LeftButton

OFF
On/Off: RedLed

Example: The Robot ARM idea

- From concept:
  - Top level properties: Angles:
    - Torso [-180, +180]
    - Shoulder [0, +90]
    - Arm [0, +90]
    - Hand [0, +90]

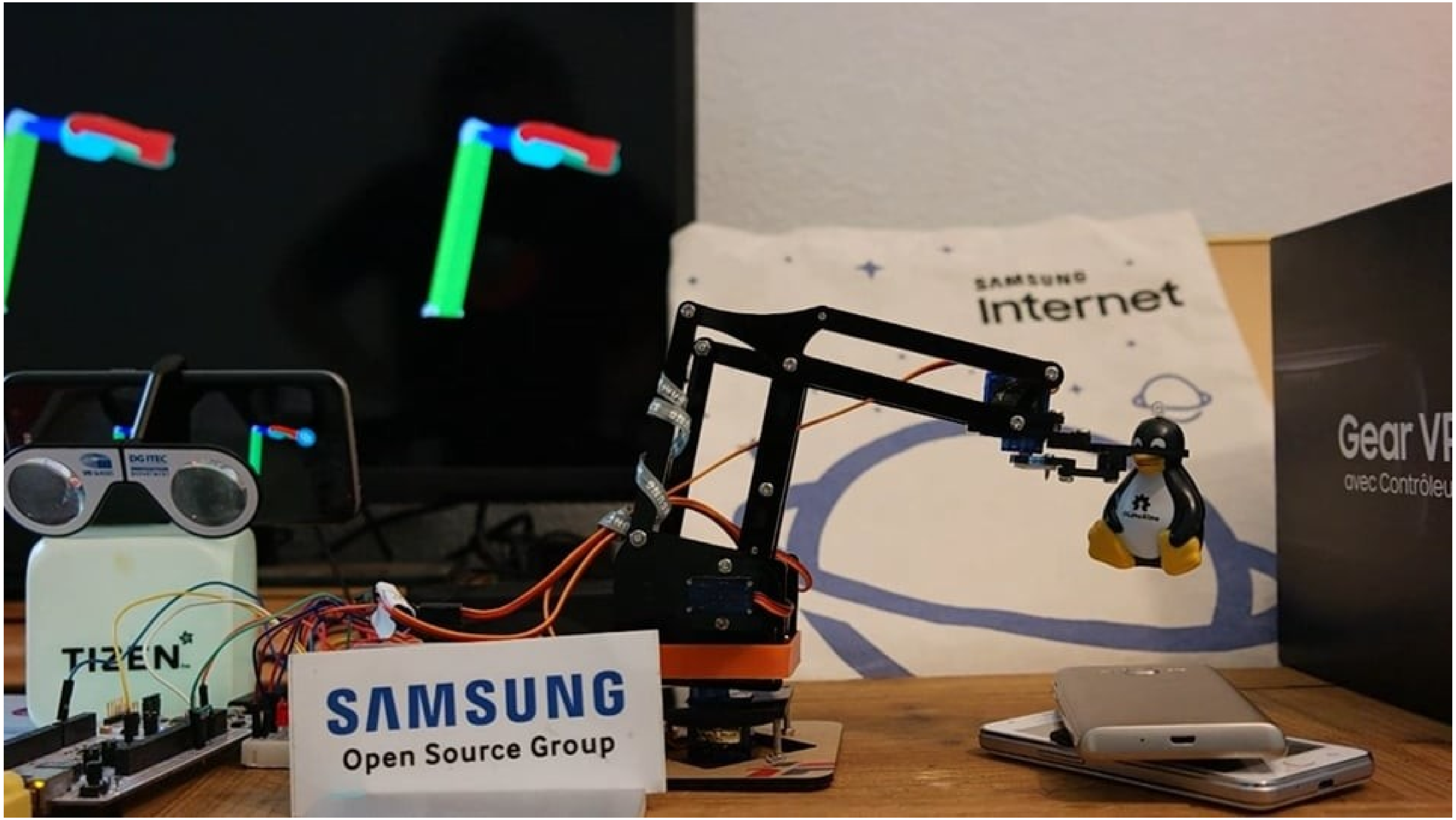


- To early specifications:
  - Design Model CAD → VR/AR
    - Simulation
    - Identify integration issues
  - Implement embedded system
    - Sourcing hardware
    - Controller / Controllee
- Adjust design/specifications

Digital Twins with WebThing-IoTjs (on STM32)

https://youtu.be/s3r8pQtzhAU/

SAMSUNG
Open Source Group



WebThing IoT.js

SAMSUNG
Open Source Group

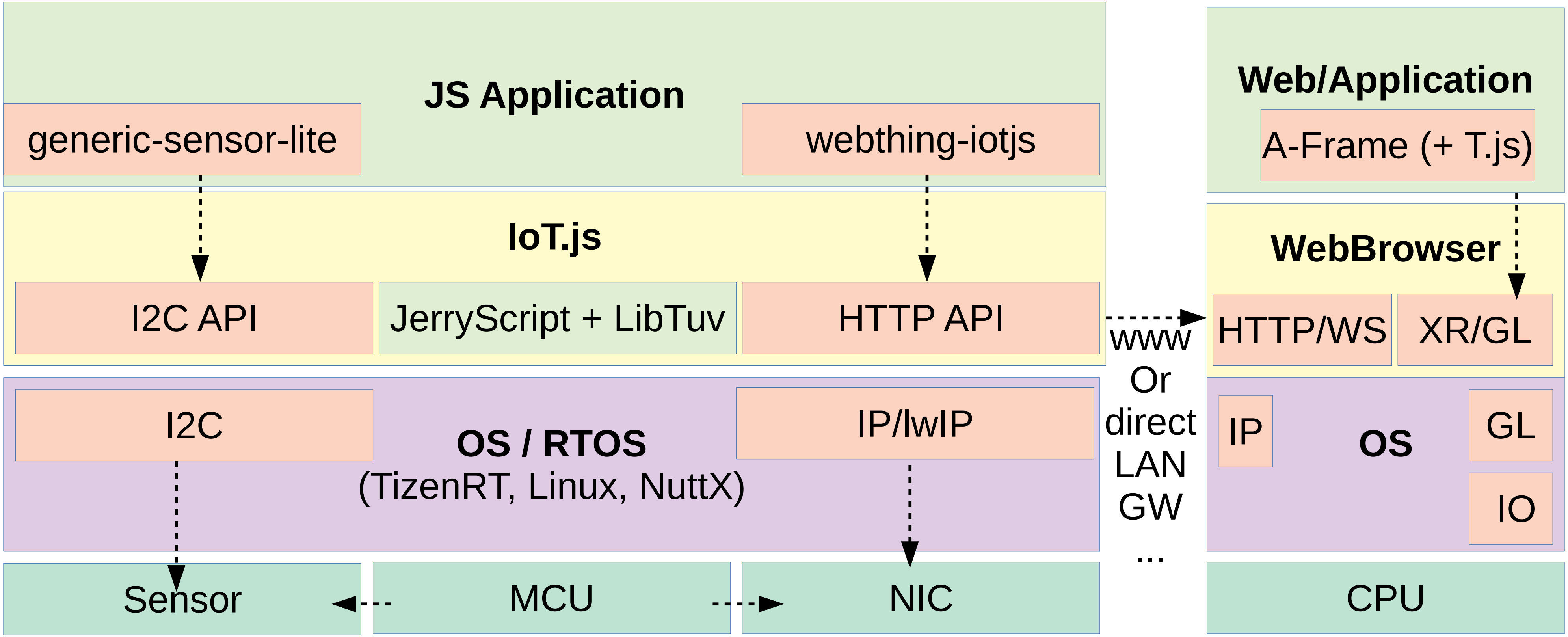
life.augmented

moz://a

W3C®

PoC Architecture Overview:

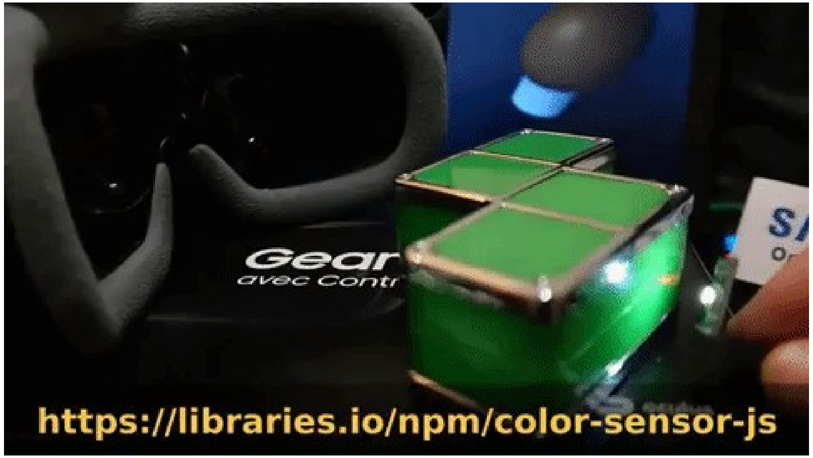
SAMSUNG Open Source Group



Run a “color sensor WebThing” with IoT.js

SAMSUNG
Open Source Group

- Install **IoT.js** for WebThing-IotJs (GNU/Linux, **TizenRT**, WLS...)
  - https://github.com/rzr/webthing-iotjs/wiki/IotJs
- git clone https://github.com/samsunginternet/color-sensor-js
  - iotjs lib/tcs34725.js # => log: value=[7779,36778,11173,42766]
  - make -C example/color-sensor-webthing start
  - curl http://localhost:8888/properties/
    {"color": "#af0695"}
- Or simulate webthing in the cloud:
  - https://color-sensor-webthing.glitch.me

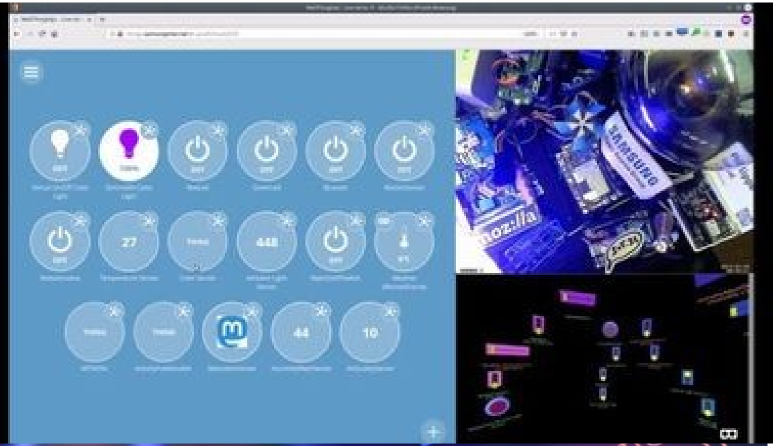


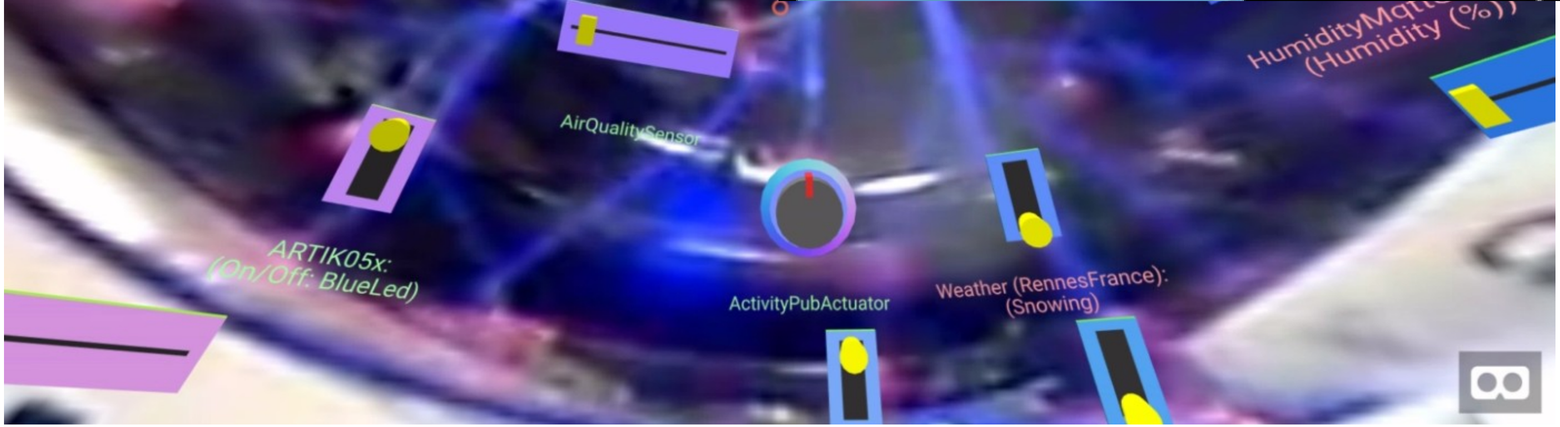
https://libraries.io/npm/color-sensor-js

Live control in 3D using A-Frame on GearVR:

https://youtu.be/s3r8pQtzhAU#wotxr-20190320rzr

https://libraries.io/npm/color-sensor-js





XR Visualization

- From WebVR
  - Implemented in Web browsers supporting WebGL
  - Various frameworks: A-Frame, Babylon-js, Three-js. GLTF
  - GPU Performance (WebGL)
- To WebXR also support Augmented Reality
  - Follow immersive web working group
- I use Samsung’s GearVR 2017 (with controller)
- Progressive Web App (PWA): to manage offline mode

Summary

- Digital Twins PoC can be implemented with JavaScript:
  - Physical Device on **Microcontroller** using IoT.js supporting:
    - I/O: Native and “generic-sensors-lite” module
    - WebThings API: Can connect to Mozilla IoT gateway
  - Decentralized architecture with Privacy By Design
- Avatar in **browser** (XR)
  - A-Frame (WebVR)
  - Align to WebThings schemas and sync nodes
- Next challenges:
  - Scalability, Persistence, GLTF (with parametric?)

Q&A ?

(or Extras?)

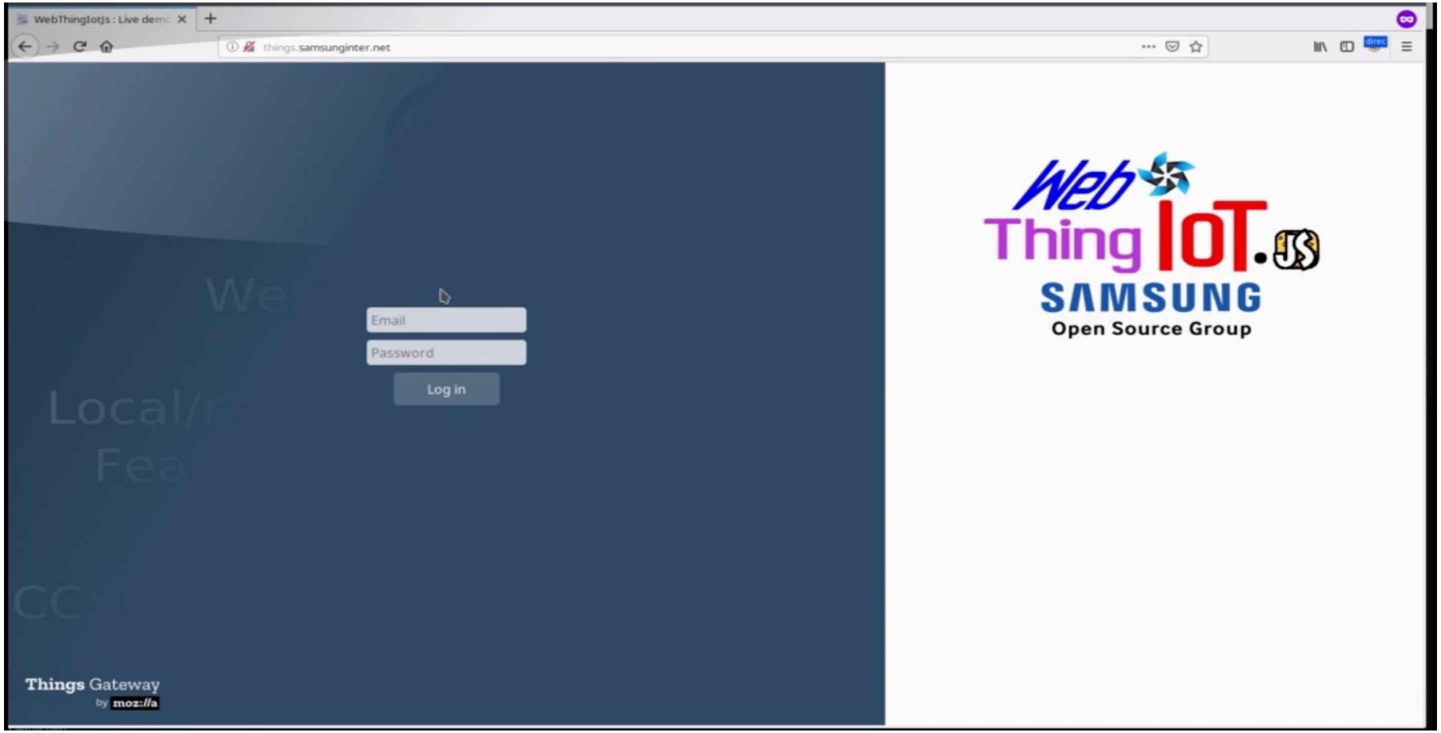
Ask now or online:
https://social.samsunginter.net/@rzr

Resources:

- Open Source:
  - https://github.com/rzr/webthing-iotjs/wiki
  - https://github.com/SamsungInternet/color-sensor-js
  - https://github.com/rzr/twins
  - http://opensource.samsung.com/
- Infos:
  - https://social.samsunginter.net/@rzr/102139995659879619
  - https://hacks.mozilla.org/2019/03/connecting-real-things-to-virtual-worlds-using-web/

Controlling real data & consuming OpenData

https://youtu.be/OT0Ahuy3Cv4#webthing-iotjs-opendata-20190202rzr



Thanks !

SAMSUNG
Open Source Group

https://Social.SamsungInter.net/@rzr

Web Thing IoT.js

SAMSUNG
Open Source Group

Resources:
Flaticons CC,
PixBay.com