Web of Twins?

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

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$ who is Philippe Coval

- 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](https://social.samsunginter.net/@rzr)
Digital Twins
What are digital twins?

- 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:

- **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
  - Microcontrollers 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
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/sUayRsjV1Ys
PoC Architecture Overview:

- **JS Application**
  - generic-sensor-lite
  - IoT.js
    - I2C API
    - JerryScript + LibTuv
    - HTTP API
  - webthing-iotjs

- **OS / RTOS**
  - (TizenRT, Linux, NuttX)

- **Web/Application**
  - A-Frame (+ T.js)

- **WebBrowser**
  - HTTP/WS
  - XR/GL

- **Network**
  - IP/lwIP
  - IP
  - OS
  - GL
  - IO

- **Hardware**
  - Sensor
  - MCU
  - NIC
  - CPU

- **Interconnections**
  - WWW
  - Or direct
  - LAN
  - GW
  - ...
Run a “color sensor WebThing” with IoT.js

- **Install IoT.js** for WebThing-IotJs (GNU/Linux, TizenRT, WLS...)
  - [https://github.com/rzr/webthing-iotjs/wiki/IotJs](https://github.com/rzr/webthing-iotjs/wiki/IotJs)
- **git clone** [https://github.com/samsunginternet/color-sensor-js](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://color-sensor-webthing.glitch.me)
Live control in 3D using A-Frame on GearVR:
https://youtu.be/s3r8pQtzhAU#wotxr-20190320rzr
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
Controlling real data & consuming OpenData

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

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

Resources:
Flaticons CC,
PixBay.com