Web of Things: HTML to Semantics towards AI

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SMARTER Project – Grant No. 661180 (H2020-MSCA-IF-2014)
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❖ Context - Web of Things Perspective of:
  ➢ Co-editor of the Joint Standard of W3C and OGC, The Semantic Sensor Network
  ➢ Co-chair of Semantic and Linked Data Task Force, W3C Web of Things Interest Group

❖ Agenda
  ➢ The Web Programming Paradigm for Things
  ➢ W3C Thing Description for Bootstrapping Semantics
  ➢ Towards AI Integration guided by “Anchored Semantics”
Abstract Architecture of WoT

Source: https://www.w3.org/TR/wot-architecture/
Core Model of Thing Description

Temperature
Canonical URL: http://iotschema.org/Temperature

InteractionPattern > Property > Temperature

Temperature interaction property

More specific Types
- ExpectedAmbientTemperature
- AirTemperature

SetTargetTemperature
Canonical URL: http://iotschema.org/SetTargetTemperature

InteractionPattern > Action > ChangePropertyAction > SetTargetTemperature

Specification of an action acting on some property of type TargetTemperature.

Source: https://w3c.github.io/wot-thing-description/
Annotating “Anchored Semantics” to Thing Description

```
{
    "@context": ["https://w3c.github.io/wot/w3c-wot-td-context.jsonld",
        {"iot": "http://iotschema.org/"}],
    "@type": "Thing",
    "id": "urn:dev:wot:com:example:servient:thermo",
    "name": "MyThermometer",
    "properties": {
        "temp": {
            "@type": "iot:ExpectedAmbientTemperature",
            "description": "Shows the current temperature of the room",
            "form": [{
                "href": "coaps://mythermo.example.com:5683/temp",
                "mediaType": "application/json"
            }]
        }
    },
    "actions": {
        "setTemp": {
            "@type": "iot:SetTargetTemperature",
            "description": "Set temperature of the room",
            "form": [{
                "href": "coaps://mylamp.example.com:5683/setTemp",
                "mediaType": "application/json"
            }]
        }
    }
}
```
Query Thing Directory with Semantic Abstraction

GET .../sparql?query=...

Select *
WHERE{
?thing td:name ?name;
  td:properties [ a iot:Temperature;
                  td:description ?tempdesc;
                  td:forms ?form];
  td:actions [a iot:ChangePropertyAction]
              td:description ?actdesc.
              td:forms ?form];
}

SPARQL Endpoint

{ Thing(limit: 1, offset: 3) {
  name
  properties {
    Temperature @type
description forms
  }
  actions{
    ChangePropertyAction @type
description forms
  }
}}

GraphQL Endpoint

JSON document

reasoning
Realtime Knowledge Graphs for Interlinking Everything (Semantic Graphs)

Towards AI Integration driven by Semantic Graphs

Towards AI integration with “Anchored Semantics”

- Anchored Semantics for parameterizing AI features
  - Unified Data model in RDF/JSON-LD for semantic interoperability
  - Semantic-driven sensor/data fusion via logic and statistical reasoners
  - Interlinking Enterprise Knowledge Graphs to IoT applications

- From Academia to Adoptions and Standardizations
  - W3C/OGC Semantic Sensor Network, JSON-LD 1.1, etc
  - Industry adoption of Thing Description and W3C Web of Things: Siemens, Intel, Oracle, Fujitsu, etc
  - More Semantic-driven IoT Standards in W3C, OneM2M and ETSI, etc

- Tool Chains for Integration of Symbolic and Statistic AI
  - Javascript: RDFJS, SPARQL.JS, GraphQL JS, TensorFlow.js and DeepLearning4J+GraalVM (Java to JS using Polyglot VM), etc
  - RDF and reasoners, Machine learning for edge devices: TensorFlow Mobile, RDF4LED (30 million RDF triples for Raspberry Zero), etc
  - Conversational AI → Semantic-driven Chatbots
Towards AI: Seamless Integration of Perceiving, Learning, Abstracting and Reasoning

More Updates at The 8th International Conference on the Internet of Things (IoT 2018), from October 15–18, 2018 in Santa Barbara, California, USA.
http://iot-conference.org/iot2018