Master of Science Topics

Ambient Intelligence and Context Management

Title: Context-aware discovery and querying of WoT Things in Hypermedia-Driven Environments

Coordinator: *Assist. Prof. Alexandru Sorici (alexandru.sorici@upb.ro)*

Description:
In the domain of **Ambient Intelligence** and the **Web-of-Things**, an important research direction is the creation of **scalable, long-lived information management infrastructures** to facilitate **search/discovery** and **querying** of **context information retrieved from physical or virtual sensors** deployed in smart environments (e.g. smart homes/offices, smart cities).

The aim in such scenarios is to enable **controlled autonomy** in **intent-driven interactions.** As an example, think of a Google Assistant like app that wants to *wake up* its user (wake up is the *goal/intent*), who is sleeping in a hotel room (i.e. not his home). The digital assistant needs to *discover* what means there are to do this (e.g. turn on a smart light bulb, automatically raise the blinds). It can only discover these options based on its *context* (it is the digital assistant of a person that is registered with the hotel and has been detected in *this particular* room).

In recent work [1] we propose a pipeline for enabling context-aware discovery of WoT services and things through the use of dynamic (RDF stream reasoning enabled) SOLID Web Access Control (WAC) Authorizations [3]. The pipeline is intended to benefit a Hypermedia-driven Multi-Agent System Platform called Yggdrasil [2].

The objective of this research project is the development of the context-aware discovery and query-answering protocol within the Yggdrasil platform, that makes use of a **dynamic stream of WAC authorizations.**

The specific challenges and goals are:

- Develop the mechanism by which querying of indexes of WoT Things is *contextualized* within the Yggdrasil Platform
- Develop a method and protocol to handle a dynamic stream of *authorization granting and revoking*
- Extend existing RDF subscription hubs implementing the WebSub protocol [4] with query subsumption techniques

This research subject continues existing work.

Keywords: Semantic Web, RDF Streams, Linked Data, W3C standards in sensor and actuator descriptions, RESTful web-services, Hypermedia-Driven agent environments

Bibliography
[1] Sorici, Alexandru. Context-Aware Search and Discovery in Hypermedia-Driven Multi-Agent Environments. Stream Reasoning Workshop 2021.

[2] Ciortea, Andrei, Olivier Boissier, and Alessandro Ricci. "Engineering world-wide multi-agent systems with hypermedia." In International Workshop on Engineering Multi-Agent Systems, pp. 285-301. Springer, Cham, 2018.
[3] SOLID Web Access Control Specification: https://solid.github.io/web-access-control-spec/. Last accessed 08.10.2021
[4] W3C WebSub protocol. https://www.w3.org/TR/websub/. Last accessed 08.10.2021.

Title: Scene understanding

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Description:
The aim of the project is to create a system capable of understanding the environment (the interior of a house). For this purpose, the following components will be developed:

- Recognition of objects from the environment; detection the objects placed on the floor and classify them based on their size
- Recognition of activities performed by the persons from the environment. It will be considered the presence of many persons in the scene.
  The analysis will be performed using images acquired with RGB-D camera (RGB and depth images). Different illumination conditions will be considered.

Bibliography:
1. https://arxiv.org/pdf/1807.05511.pdf
2. Kong, Y., & Fu, Y. (2018). Human action recognition and prediction: A survey. arXiv preprint arXiv:1806.11230.
3. https://arxiv.org/pdf/2104.13586v1.pdf