

# Internship offer: Is your robot smart enough to turn on the light ?

## Context : IoT and interoperability

The Internet of Things is about connecting everyday life items to each other to extend their capabilities. Devices produce streams of data that are collected, processed, stored and used by applications to offer services such as blinking a LED (50 % of IoT demos<sup>1</sup>) or paper roller tweeting when you are out of paper<sup>2</sup>.

However, the diversity of IoT devices and their vendors makes interoperability an issue : devices can't always communicate with each other, and applications have to be developed specifically for each technology. Standards can bridge the syntactic gap (« the pipes »), but in M2M (machine-to-machine) communication, the meaning of the data we put into the pipes must also be shared by source and target devices to obtain semantic (meaning) interoperability.

Such sharing of conceptualization is enabled by the semantic web principles and technologies. The semantic web is constituted of expressive shared vocabularies (ontologies) and of linked data (data described with ontologies). By combining the semantic web and the internet of things, one can make a step toward interoperability, and develop applications based on heterogeneous devices with discovery and autonomic management capabilities.

## Motivation for the intership :

At LAAS-CNRS, we have complex robots that can perform multiple tasks, such as piling up cubes or handing glasses of water to humans. Moreover, we have a connected apartment where you can easily switch on fans or measure temperature. Multiple devices are installed in this apartment, and other devices can be added at will depending on the experimental needs.

Initial work has been done to establish a connection between the robot and the connected devices, making the robot able to tell the temperature in the room for instance. The internship purpose is to give the robot discovery capabilities to explore the network of devices with minimal a priori knowledge in order to extend its own capabilities and to make new data available for the devices.

## Illustrative use case :

In an elderly care use case, the robot can be used to bring medications to people at scheduled time, and to provide assistance to people in distress. However, the perception of the robot is limited to its sensors (cameras, lidars), so it has to move around to analyze the situation. However, its behavior

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1 <http://www.commitstrip.com/en/2016/05/26/the-internet-of-things-a-revolution/>

2 <https://www.kickstarter.com/projects/26703418/rollscouttm-go-in-peace?ref=discovery>

could be optimized if it had access to heart monitors or presence sensors inside the home, and if it could provide additional information to medical personnel if a human intervention is required.

## **Expected work :**

The intern will contribute to :

- The specification and the implementation of a precise use case
- A survey of existing approaches in robots/IoT interactions
- The discovery of devices based on their semantic descriptions and on the needs expressed by the robot
- The adaptation of the behavior of the robot based on the available devices

The intern will be integrated in teams of researchers and technical service. After a short training on robot and IoT, the intern will supervised by one researcher on robotic and one on IoT. Daily work will be done with strong cooperation with a PhD students and 2 engineers. Anyway, capability to work in autonomy will be appreciate.

Good practice for software development will be used: Agile method for fast prototype creation, versioning of software, documentation and dedicated project space.

This internship could be followed by a PhD grant.

## **Technologies at stake :**

Prerequisites :

- Java, but an understanding of python would be a bonus
- Semantic web technologies (OWL, RDF, SPARQL...)
- Linux-based systems

Bonuses :

- The robot is based on ROS
- IoT technologies in general, OM2M in particular

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