Theories about World Representations for the Internet of Things

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The question of how to represent knowledge about the world has been an integral part of computer science and cognitive science. In the past, computer scientists (and logicians) could define the semantics of items in their knowledge representation models and methods for describing the world largely without an explicit connection to reality. However, as networked devices are not only aware of the world (they are able to perceive the world via sensors) but are also able to trigger change in the world via actuators, we need to update previous theoretical foundations of data management and logical languages that did not consider these new dynamic scenarios in which pieces of software perceive and act in the real world in an automated way. In the scenarios, surrounding the Internet of Things in particular, changes in the represented world immediately affect changes in the real world, and vice versa.

In our work, we turn to philosophy to find the answers to the new problems of dynamically changing worlds and world representations (e.g., ontologies) that arise for computer scientists in the area of the Internet of Things.[1] We have identified the following aspects to help provide theoretical foundations for the scenarios that emerged in the context of the Internet of Things and cyber-physical systems:

1. *Theory of inter-subjectivity between machines and humans:* On the Internet of Things, machines should carry out tasks for humans. For that to work, humans need to be able to communicate with machines, and vice versa. Questions around symbol grounding [2], truth theories [3], and the various theories of meaning [4] have to be addressed. The symbol grounding problem comes into play when we consider the proverbial light bulb connected to the internet [5]. How can we assign (and agree upon) an identifier for a specific light bulb? How can we make statements about whether the light is on or off? How can a human and a machine agree on which symbols to use? What

[1] See, among others, Peschl and Riegel [1], who have already proposed the need for those answers in general.

are appropriate languages and representations for communicating the state of things in the real world and delegating tasks?
2. *Dynamic Ontologies:* Currently widely used knowledge representation languages, such as the Web Ontology Language (OWL) [6], are suited for representing how the world is, not how the world evolves. Emerging technologies try to combine these current knowledge representation languages with the network protocols for communication used on the internet and the web, with varying degree of success. How can we represent dynamic knowledge (related to grammatical aspects [7]) in a machine-interpretable way?

Our goal is to survey the ideas and theories from philosophy to address use cases in the area of computer science. Specifically, we want to find practical implications of choosing one theory over the other in the context of the Internet of Things. Addressing the above mentioned questions has potential benefits for both computer scientists and philosophers.

References

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