Collaborative Discussion 2: OO Design for IoT

Making reference to the article by Fortino et al. (2015), consider the strengths and weaknesses of designing a metamodel to support object-oriented design of the IoT. Design a smart model equivalent to that presented in Figure 6 which would instead support operation of a driverless car.

Initial Post:

The article by Fortino et al. (2015) proposed a development methodology for the design of smart object-focused IoT systems via agent-orientation using metamodels. The paper covers three aspects in the development stage: 1) analysis phase, defined by a high-level smart object metamodel; 2) design phase, requiring modelling of functional attributes and the relationships and interactions between them, and 3) implementation phase contextualises it with respect to the Java Agent DEvelopment Framework (JADE). The following are strengths and weaknesses of designing a metamodel:

1. Strengths
    1. Conceptual: Can be utilised across multiple domains and business use cases
    2. Compartmentalised: Ease of understanding and development as implementation and interface are defined separately
2. Weaknesses
    1. Generic: Struggles to capture sufficient real-life detail of business-specific entities

2. Incompatibility: Given above loss of detail, a model has higher risks of being wrongly defined and may be unable to sufficiently adapt to evolution via implementation

Henderson-Sellers (2011) discuss the alternative of a foundational ontology or a “meta-ontology” to encapsulate the necessary attributes sufficiently.

A smart model equivalent for a driverless car operation can introduce the concept of an agent, as described by Savaglio et al. (2020), being a “sophisticated software abstraction defining an autonomous, social, reactive and proactive computational entity”. All high-level components, Fingerprint, PhysicalProperty, Service, Device, Status and Location, are relevant to the design of a driverless car.

References:

Fortino, G., Guerrieri, A., Russo, W. & Savaglio, C. (2015) Towards a development methodology for smart object-oriented IoT systems: A metamodel approach. In *2015 IEEE international conference on systems, man, and cybernetics* (1297-1302). IEEE.

Henderson-Sellers, B. (2011) Bridging metamodels and ontologies in software engineering. *Journal of Systems and Software*, *84*(2): 301-313.

Savaglio, C., Ganzha, M., Paprzycki, M., Bădică, C., Ivanović, M. & Fortino, G. (2020) Agent-based Internet of Things: State-of-the-art and research challenges. *Future Generation Computer Systems*, *102*: 1038-1053.