Ontology-based reflective Iot middleware-enabled agriculture decision support system

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Abstract. Modern agricultural management relies strongly on many different sensing methodologies to provide accurate information on crop, climate, and environmental conditions. Strong challenges in Decision Support Systems still regard the way a smart IoT-based architecture is designed in order to make it robust with respect to the contextual changes it continually undergoes.
In this paper we propose an extensible self-adaptive Decision Support System for managing heterogeneous data sources.

1 Introduction and motivation

More than one third of the world's labour force is employed in agriculture field, which is one of the most dangerous of all sectors and many agricultural workers suffer occupational accidents and ill health. The main focus lies on administration's methods of agrochemical inputs through changes in management to assure adequate plant nutrition and plant protection through organic nutrient sources and Integrated Pest Management(IPM), respectively. Farmers need information, at the right time, to take more informed and optimal decisions in time of their day to day farming practices. In the last few years, monitoring and agriproduct systems are developed using Internet Of Thing (IoT) and Cloud Computing. IoT middleware is a software that serves as an interface between components of the IoT, making possible a smoother and homogeneous communication among elements that otherwise would not be capable.

2 Proposed approach and Instantiation of the model

We propose to adopt the reflective paradigm for modeling an IoT middleware, by implementing the software design pattern *Reflection*[2]. In this way we can designing a completely configurable and extensible IoT system, adaptable to different operating environments. The main concept in *Reflection* pattern is the distinction between *base-level* and *meta-level*. Let us consider its instantiation in a use case scenario, i.e. consider the agricultural domain and challenges related to the management of pesticides[1]. The scheme in Figure 1 is an overview of the implemented framework. The system will automatically perform actions according to the data received by the sensors of devices by matching the set of formal rules. Variables to be monitored are air, temperature, humidity and fine dust emissions.

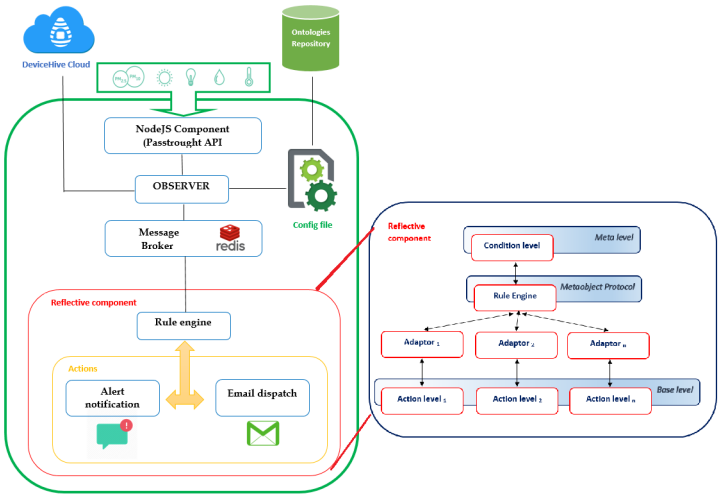

Fig. 1: Architectural schema of instantiation model.

In this instantiation we model an OWL 2 ontology using part of Agrovoc (a controlled vocabulary covering all areas of interest of the Food and Agriculture Organization) thesaurus concepts and the support of human experts. The ontology contains the main knowledge related to pest management and control with particular reference to the guidelines issued by the Ministry of Agriculture.

3 Conclusion

Agriculture in urban areas have become a new trend. This field is one of the most dangerous of all sectors. We propose an ontology-based Decision Support System enabled by a reflective extension of an IoT middleware. In this way, the proposed tool, using a user-friendly website, *Farmers* can *(i)* obtain all the general information related to crops, plant diseases, treatments, commercial products, doses, Active substance, defense plans, fertilizers, and so on; *(ii)* receive alerts, personalized defense plans, fertilization plans, real-time weather information, etc., after subscribing an account on the website, indicating their crops.

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