UI design patterns in IoT-based Business Process Digitalization

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EXTENDED ABSTRACT

Nowadays, an enormous amount of data ("data deluge") are produced in Smart Cities scenarios, which are characterized by Internet of Things (IoT) systems (including embedded systems, wireless networks, personal devices as smartphones, tablets, wearable objects) widespread across the territory and involving a multitude of actors. These data represent value for business processes, but, in order to respond "in real time" to customers' needs and requirements, new business models must be developed. This implies a transformation of traditional business processes (BPs) involving IoT systems, which are not anymore just data sources, but take part actively and interact with the various business processes that have become cross organizations.

Effective digital transformation of BPs is fundamental in order to offer efficient services to users who, for example, would like to connect to the website or make a call to the call center of an energy supplier and have the service activated in a few minutes. However, the digital transformation of BPs, and their subsequent re-engineering, is a complex task that small and medium-sized enterprises (SMEs) often cannot afford. Pattern-based digital transformation of BPs permits to reduce such a complexity by maximizing the reuse in different contexts of well-established solutions to recurring problems.

Literature offers research works that address modeling and integration of IoT in BPs by proposing the extension of the process modeling standard, also using semantic technologies [1, 2]. However, when it comes to creating an application or a service, there is still some gap regarding the most suitable semantics both for describing the application domain and for considering the different types of users that interact with it. The result of a BP digital transformation must be easy to use and intuitive, allowing an effective interaction and a user experience able to reduce the complexity of the underlying processes resulting also from the interconnection with IoT. This raises important issues related to usability, requiring the use of methods typical of Human-Computer-Interaction such as Human-Centered Design (HCD) [3]. My research aims at the definition of methodologies and tools for pattern-based digital transformation of business processes (BPs) in the context of Smart Communities and Industry 4.0. I propose a semantic approach to the definition of User Interface (UI) patterns for IoT applications, through a three-layer model representing the IoT-UI-BP triple, according to the Model-View-Controller (MVC) macro pattern (see Figure 1).

The ontological model is composed of the ontologies that Technical experts should use for developing IoT applications and it shows how the ontologies are connected each other. Contextualization and modeling domains are formalized in the process design phase, through semantic annotations of IoT and BPs; the design of the user application interfaces is based on specific ontologies (End-User Interface Ontology, bottom-right in Figure 1) describing the most suitable graphical constructs for the specific user and on the vocabulary used in the domain (Sub-Domain Ontology, center-right in Figure 1).
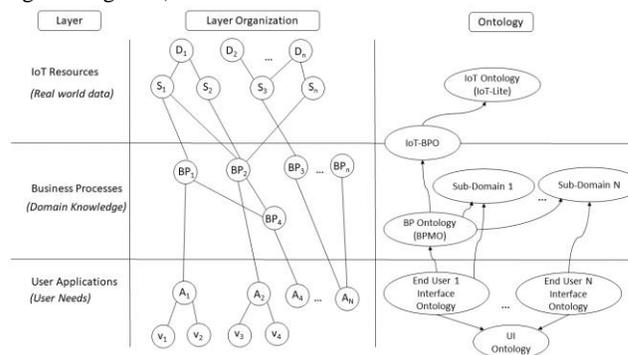

Figure 1. Three-layer model representing the IoT-UI-BP triple

The ultimate goal is to develop a methodology for translating process modeling constructs into the most suitable UI design patterns, using semantic annotations of the entire triple IoT-BP-UI. For example, in the Public Administration domain, data on CO_2 and Pm_{10} provided by a sensor inform the Environment Department employee about air pollution trend over time. The same data can be an index of traffic congestion over time for the Mobility Department employee. A citizen, in order to correctly interpret the same data, needs a suitable representation, as a geochart (e.g, a map reporting colored circles according to the calculated values), a simple explanation (e.g., "high-medium-low pollution level") or a push notification service for his/her mobile device (e.g., by a Telegram channel). In order to validate the approach we want to extend a BPMs in order to make it IoT semantically aware, integrated with a semantically enriched UI editor.

ACKNOWLEDGMENTS

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