Ambiance Intelligence Approach Using IoT and Multi-Agent System

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ABSTRACT

Internet of things is a network of objects mainly supported by electronic devices and electronic components such as sensors and electronic cards. These objects can be physical and virtual devices, sensors or actuators, are autonomous and have their own intelligence characteristics. On the other hand, smart environments are those in which sensors and actuators have been integrated, to react to events and to adapt to those present. The environment acquires intelligence through its intelligent components, or through the intelligence resulting from its interaction with other components. Our contribution is a proposal of Cognitive IoT (CIoT) devices structure by adding an agent layer to the device. Such layer provides the device with agent characteristics (intelligence, autonomy, cooperation and organization).

KEYWORDS

Agent, Agent Layer, IoT, MQTT

1. INTRODUCTION

Nowadays, the Internet is heavily used by humans, through computers and mobiles; indeed main communication in the world is being carried out between humans using Internet. The Internet of Things (IoT) is a present and future technology, which can involve physical and information system worlds through the use of sensors. Therefore, most current human-to-human interactions will become as the human-to-machine interactions in the near future.

In this scope, we investigate the additional mechanisms to communicate with the IoT and there is a need to exchange information between nodes. Things have the ability to cooperate, communicate and adapt independently, but this requires re-considering the structure of such devices/things.

Several papers analyse the global architecture of the IoT systems, but we rarely find studies on the structure of the thing itself. The current structure, which can be found in several research papers (Karagiannis, Chatzimisios, Vazquez-Gallego, and Alonso-Zarate, 2015), is a rigid and passive architecture with a status on which one can perform operations. The thing (object) is dependent on

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acting with the intervention of a third party (human or object) and functions as a Programmable Logic Controller (PLC) with predefined statuses. In this proposal, we examined the structure of the thing and found that it loses key features such as autonomy and intelligence. This motivated the main aim of this paper. It is novel if the addition of an agent layer to the IoT devices is done, providing it with agent characteristics. This way, the device will be enriched with the ability to work autonomously in an environment, directly communicate with other agents, and coordinate, collaborate and cooperate with other objects (other devices). We bear in mind the limited capacity and power of the device, and paid attention to preserve and exploit it properly. This is why we used the Message Queuing Telemetry Transport (MQTT) protocol in the process of exchanging commands and information between the IoT device and the user. Moreover, we used the JADE platform to host the agent so that the device become a smart element and it is always connected to the IoT Gateway. In all processes that require great capacity and energy, we can maintain the energy and the ability of the device in this way, even though it is directed on the application side (has a specific application), and it will provide its service to the fullest.

The rest of the paper is organized as follow: In section 2 we introduce the area of our research work, in section 3 we briefly discuss related works. Section 4 describes the proposed structure and its features, the section 4 outlines the implementation of the CIoT device structure. Finally, some conclusions and perspectives are presented.

2. BACKGROUND

In this section, we are going to introduce the main concepts and technologies used in our approach.

2.1. Internet of Things

The IoT is a set of computing devices, objects, mechanical and digital machines (Gubbi, Buyya, Marusic, and Palaniswami, 2013). Such entities remain connected to the Internet, and are integrated with one or more sensors (Minerva, Biru, and Rotondi, 2010). Currently, IEEE standard association considers three layers in IoT architecture, as shown in Figure 1 and explained below:

- **Application Layer**: It represents the software level. It varies according to IoT markets and stakeholders;

Figure 1. IoT architecture (Wu, Lu, Ling, Sun, and Du, 2010)
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