WebAlive: a New Paradigm for Bringing Things to Life on the Web

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ABSTRACT

In this poster, we propose *WebAlive*, a new paradigm that brings any Thing in the realm of reality to 'life' on the Web by creating an *entangled* virtual existence for it. For example, consider a physical object like the lamp on your desk. As a human, you are aware of its existence. You can see it, touch it, feel it, interact with it (turn it on, off, etc.) and investigate its attributes (color, material, etc.). You can even alter or trash it. Now, imagine that the lamp had a virtual counterpart on the Web such that the two of them were *entangled* with each other. A software agent on the Web can now become aware of its existence, it can perform actions on it, learn about its attributes and even (with the right capability) alter it just how it was accessible to you. Referring to the most broadest definition of the word Thing, we can extend this *entanglement* concept beyond physical things like devices, objects, people, etc. to all intelligible things like entities, processes, concepts, ideas, etc. By doing so, we can open a new realm of possibilities where we could have digital access to the world around us. This poster provides an introduction to the paradigm and its realization.

Categories and Subject Descriptors

H.3.5 [**Information Storage and Retrieval**]: On-line Information Services

Keywords

Web Science; Web Architecture; Internet of Things; Linked Data

1. INTRODUCTION

In philosophy, Ontology is the science of what *is*, the kind of structures of objects, properties, events, processes and relations in every area of *reality*[6]. Things in the realm of reality can be broadly classified into two (i) material things that you can touch, see and perceive with the senses (like lamps, books, the planet Mars, etc.) and (ii) the intelligible

non-materialistic things conceived with the mind (e.g. the concept Zero, the entity of 'The City of Sunnyvale', happiness, etc.). The world, for us, is made of these Things.

The core idea of the *WebAlive* paradigm is the *entanglement* of the Thing from the real world with a resource on the Web that would be its virtual counterpart. This has multiple implications. First, as described in the abstract, a software agent on the Web (e.g. home automation agents, search engines, smartphone assistants, etc.) can access any Thing just as how it is accessible to people. Second, as a consequence of having a software driven virtual counterpart, the operations possible on the Thing can can be extended to additional features like remote operations, talking to it via a speech interface, etc., which can now be accessible to the user. Third, since the relationships between Things can be embodied in the links between their virtual counterparts, software agents can navigate the world around us.

2. RELATED WORK

Entities in the current Web Architecture (such as websites, web-pages, etc.) are phenomena created solely for the Web (originating from a 'resource retrieval' paradigm [5]) and do not reflect the nature of Things in the real world. The Internet of Things (IoT)[1] is characterized by connections between electronic 'Things' (such as embedded devices with RFID tags, sensors, actuators, mobile phones, etc.) it lacks the broader vision of connecting things like people, processes etc. that are non-electronic. Even the Internet of Everything[3] that aims at interconnecting People, Data, Things and Processes to encapsulate a larger scope (like cities, etc.) similarly limits the 'Things' it investigates to "physical items like sensors, consumer devices, and enterprise assets". In contrast to these, the fields of Semantic Web and Linked Data[4] make it possible for a software agent to access a web of data about 'Things' can be physical (e.g. places, species, etc.) or abstract (e.g. encyclopedic information). However, their use has largely been restricted to representing and interconnecting databases and ontologies (computer science). Also, they do not define the exact relation between the virtual resource and their corresponding real world Things. As such, these existing paradigms lack a unified theory that can cover all Things from the real world, their relations and their representation on the Web. The *WebAlive* paradigm proposes to achieve this unification.

3. THE WEBALIVE PARADIGM

Making a Thing *WebAlive* requires (a) the creation of a resource on the Web that is a virtual equivalent of the Thing,

(b) capturing the state of the Thing into the software behind the resource, (c) providing an interface to the resource for exploring its attributes and interacting with it, and (d) providing an interface for defining & navigating relationships with other Things. Once *entangled*, interactions with the virtual Thing would bring about a change in the state of the Thing in the real world and vice-versa.

3.1 Publishing a Thing on the Web

For the sake of brevity, we list a set of rules (similar to the Linked Data Principles[1]) to publish a Thing on the Web.

Rule 1: Virtual Existence - Create a Web resource (i.e. a LiveNode) for each Thing in the real world to be published.

Rule 2: Identification - Use an HTTP URI to uniquely identify and locate the LiveNode.

Rule 3: Interfaces - Use standard HTTP methods (and HTTP Response Codes) to interact with the LiveNode.

Rule 4: Syntax - Use standard structured data formats (like N3[2]) for the request / response and use the `Content-Type` *header to negotiate them.*

3.2 Degrees of Entanglement

Each LiveNode should also specify its degree of *entanglement* that reflects its levels of synchrony with the Thing.

Degree	Description
1 - Existence	There exists a LiveNode for a Thing- i.e. the URI for the LiveNode can be looked up (without a 404 error).
2 - Read-only, with latency	The state of the Thing can be read from the LiveNode or it can be queried, but some information may not be in sync with the Thing and is possibly outdated.
3 - Read-only, web-synchronized	The state of the Thing can be read from the LiveNode or it can be queried, and its information is in sync (barring network latency issues).
4 - Updatable, with latency	An interaction with the LiveNode will update the state of the Thing. However, the update may not reflect immediately.
5 - Updatable, web-synchronized	An interaction with the LiveNode will update the state of the Thing simultaneously (barring network latency issues)
6 - Constant and always synchronized	This level is relevant for Things that do not change e.g the number zero, things in the Ontology of the publisher that do not change.

3.3 Interactions

Apart from supporting interactions possible in the real world (e.g. operations for the home automation agent, transfer of ownership, etc.), the LiveNode can also capitalize its software nature as a means to provide additional interactions with the thing (like remote operations, speech, etc.)

3.4 Topology

The topology of the LiveNodes in the *WebAlive* paradigm closely follow the Ontology behind the Things that they represent. First, the link between them represents the relationship between the corresponding Things. As an example, Figure 1 shows a (partial) topology of the LiveNodes related to the lamp. Second, as a result of Ontological inheritance,
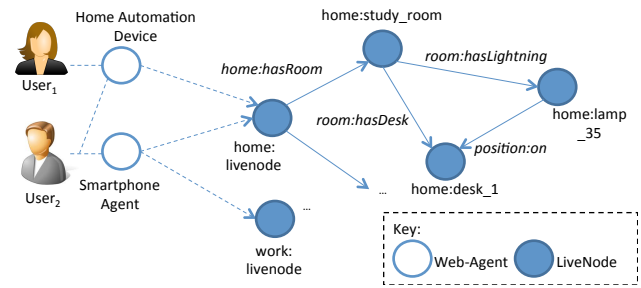
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[1]http://www.w3.org/DesignIssues/LinkedData.html

Figure 1: (Partial) Topology for the Lamp Example

WebAlive promotes natural code re-use. Additionally, other things on the Web that are part of *WebAlive* paradigm (e.g. web-sites, search engines, smartphone assistants, etc.) may also interact with them.

4. VISION & APPLICATIONS

Numerous applications can be possible. For example, patients can be connected with Hospitals and Doctors; who in turn can administer healthcare using medical devices and prescribe medicines; which are connected with their makers who provide details on the usage and composition. People can be connected with books that are connected with the publishers and authors; and have the ideas that they present connected with other authors' ideas; and can be used as coursework for schools or leisurely read at a coffee shop. The possibilities of such a unified platform are limitless.

5. CONCLUSION & FUTURE WORK

By *entangling* Things with LiveNodes, the *WebAlive* paradigm enables web-agents to seamlessly interact with the world around us and, hence, be part of it. The real world is also augmented by the additional interactions that are possible virtually on *WebAlive*. The vision that these two capabilities help us realize is that of a Web-augmented version of the world and creates a very natural and intuitive way of representing Things on the Web. The *WebAlive* paradigm allows for a unified platform for connecting Things with each other. As future work, we aim to explore the pragmatics of the interactions with the LiveNodes in detail.

6. REFERENCES

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