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Smart Cultural Heritage model development using smart objects-oriented IoT

Chaitanya Shah

Student at Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

Abstract

In the future, Internet of Things (IoT) will be used widely with smart objects as the fundamental building block in the development of wide variety of applications of various domains ranging from logistics and healthcare to smart grid and smart cities. The implementation of smart objects-oriented IoT is a complex challenge as it involves the use of distributed, autonomous and heterogeneous sensors, cloud services and other IoT components. In this paper, we are proposing a smart cultural heritage model which uses sensors, client devices, cyberphysical environment to promote and preserve the cultural heritage.

Index Terms- Internet of Things (IoT), Smart Cultural Heritage, Smart objects-oriented IoT, Cloud Computing

Introduction

IoT consists of heterogeneous cyberphysical objects such as sensors, smart objects, etc. The smart objects have unique identities, physical attributes and communication interface based on the standard communication protocols. The smart objects are embedded into global information network to use it in IoT domains such as healthcare and transportation.

In this paper, we will focus on a smart objects-oriented IoT to propose an architecture for smart cultural heritage. Smart objects-oriented IoT s a decentralized and loosely coupled systems of cooperative smart objects (CSOs). The development of IoT smart objects with cloud computing methodology provides flexible and powerful storage and computing resources. This procedure helps to perform dynamic data integration. This paper proposes a high-level design of a cloud-based smart objects-oriented IoT which uses sensor-cloud infrastructure for sensor streams collecting and analysis. [2]

Smart Cultural Heritage

Smart cultural heritage can be developed using cloud computing, sensors and IoT devices. Smart cultural heritage aims to promote and preserve the cultural heritage through smart applications and participatory processes. [1] The Cloud Computing paradigm provides flexible, robust and powerful storage and computing resources, which supports extreme scale computation through virtualization, dynamic data integration and fusion from multiple data sources. Cloud computing layers (Infrastructure as a Service - IaaS, Platform as a Service - PaaS, Software as a Service - SaaS) and software components (e.g., databases, data mining workflow tools) can be customized to support a distributed real-time system for the management and analysis of IoT objects and data streams generated by IoT objects. [2]

The different cloud computing layers can be described as:

1. Infrastructure as a Service (IaaS): The IaaS refers to all the hardware, network equipment, web servers which the cloud service providers rent out to the cloud consumers. Examples: Server nodes, Hypervisors, etc.
2. Platform as a Service (PaaS): The PaaS refers to the services provided by the cloud providers to create applications, software and web tools. For Example: The developer can use cloud service from Amazon which comes with pre-installed developer tools like Apache, MySQL, GitLab, etc.
3. Software as a Service (SaaS): This layer is the topmost cloud layer. SaaS is utilized by the majority of the consumers. Software as a Service is used to provide various applications, programs, software and web tools to the cloud consumers at a low price. For example: When we use Google Play Store, App Store, Adobe Suite, or any other cloud based software which is stored in a web server located we are accessing the SaaS layer of the cloud. [4]

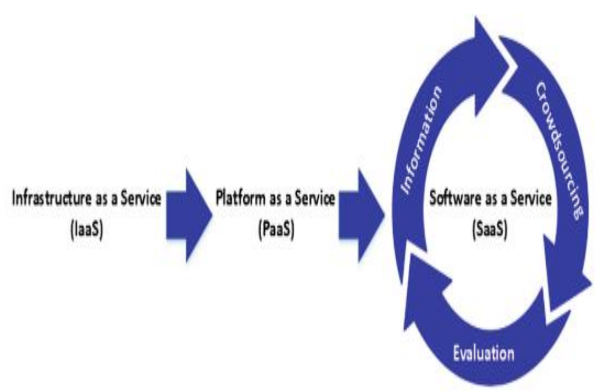

Figure 1: Cloud computing layers [1]

Smart objects-oriented IoT High Level Architecture

A high-level layered architecture for the smart objects-oriented IoT with four layers is explained as follows:

1. **Application layer:** It includes services and applications based on smart objects and also on other cyberphysical and/or business-oriented IT infrastructures.
2. **Middleware layer**: It provides a set of fundamental mechanisms for smart objects naming, discovery, high-level interaction (and coordination), and management.
3. **Internet layer**: It embodies application, transport, and network protocols for effectively supporting communication with and among smart objects.
4. **Smart Object layer:** It consists of available programming frameworks and tools for the design and implementation of SOs.

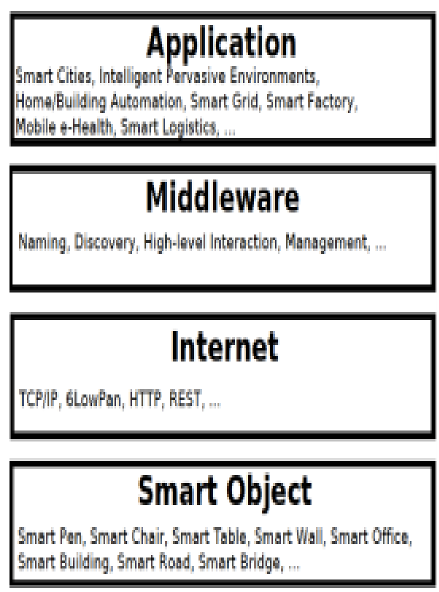

Figure 2: Smart objects-oriented IoT layers [2]

Cloud computing services usage in smart objects-oriented IoT

The smart objects-oriented architecture uses the cloud computing services in the following manner:

SaaS gathers and process sensor data to the Cloud-side through an Android-enabled mobile device. Sensor data collection is currently based on Android-SPINE, the Android version of SPINE.

Cloud-side provides (sensor) data collection and archive, on-line/off-line processing/analysis and visualization.

Workflow defines a data-flow process that analyzes input data to generate output data. It consists of one or more nodes organized in a directed acyclic graph. A node is a specific algorithm that can be developed according to the Workflow Engine API.

View formats the visualization layout of the output data for the Viewer-side.

Analyst-side supports the development of new application services.

Viewer-side presents the output produced by the data analysis through advanced graphical reports. By applying the View specification to the data, the graphical view is automatically generated. The Viewer-side is currently based on jxReport, a Java library that has been purposely implemented and integrated into the client application. [4]

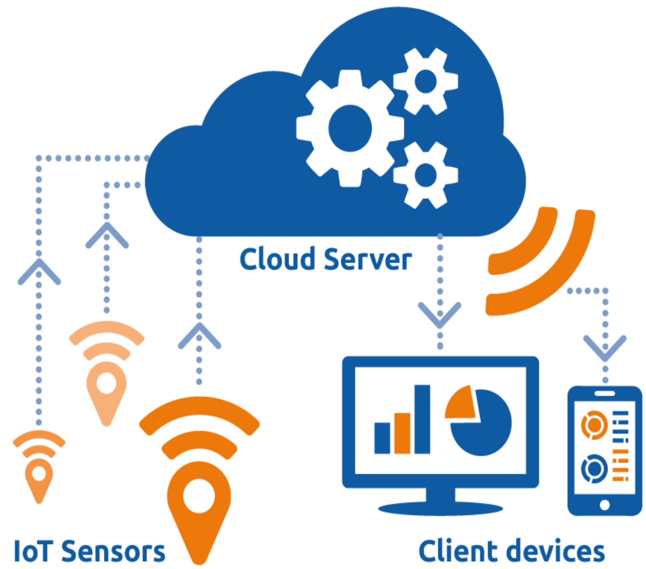

Figure 3: Architecture of smart cultural heritage [3]

Smart cultural heritage model

Smart cultural heritage aims to promote and preserve the cultural heritage through smart applications and participatory processes. [1]

The various components of the smart cultural heritage model are:

a) **Smart User Agent**: It models human users in the context of smart systems. It therefore provide GUI-based functionalities through which users can formalize and submit service requests.
b) **Smart Interface Agent**: It defines an interfacing agent such as brokers, mediators, wrappers. Specifically, they are able to coordinate smart object agents and/or wrap components of external IT systems.
c) **Smart Object Agent**: Smart Object Agent formalizes a cooperative smart object through a specific agent model embodying hardware and software components.

d) **CyberPhysical Environment: This environment** refers to the non-agent-oriented logical and physical context (made up of logical and physical components) in which agents are embedded. It can be modeled in terms of a reactive/proactive environment abstraction that is able to interact with agents according to an event-driven coordination model.

e) **Cloud Computing Platform**: The cloud computing platform supports all smart agents, empowering their specific resources. In particular, it allows for the definition of new (virtual) smart object agents as meta-aggregation of existing smart object agents.

f) **Smart agent enhancement**: The Cloud platform has to provide new functionalities to dynamically created new virtual (smart user, interface, and object) Cloud-based agents than run on the Cloud-side but are seamlessly linked to the basic smart agents.

g) **Smart object management**: Multitude of smart objects has to be effectively and efficiently managed through mechanisms that scale from localized highly dense to large-scale decentralized cooperative smart objects systems.

h) **Smart object data stream collection and management:** Data streams coming from highly decentralized smart objects need to be efficiently uploaded onto the Cloud-side and effectively managed.

i) **Workflow-oriented analysis of smart object data:** Decision making applications should be dynamically developed through distributed workflows defined at the Cloud-side involving smart agents and cloud services.

j) **Security:** Smart cultural heritage model developed should be secure. [2]

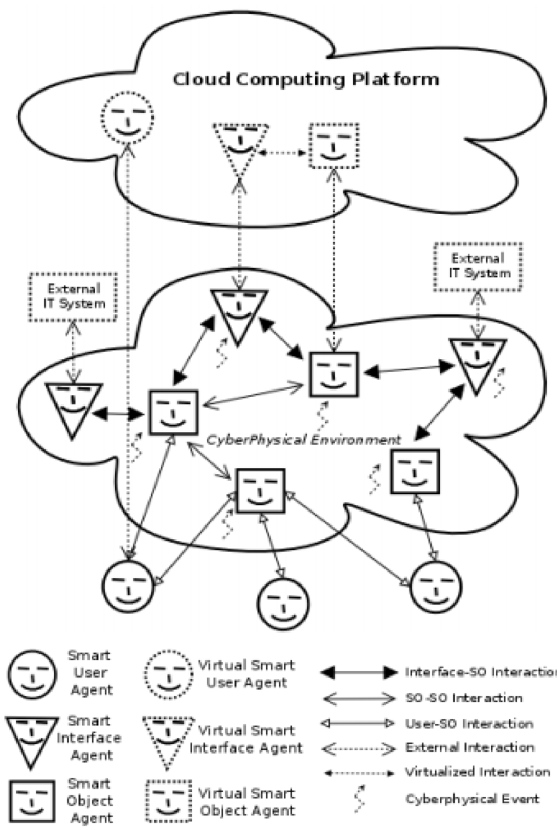

Figure 4: High Level Smart objects-oriented IoT architecture [2]

Conclusion

In this paper, we have provided the high-level design of smart cultural heritage model based on smart objects-oriented IoT systems using the concept of Cloud and smart agents. Smart objects could be empowered in terms of processing power and storage resources through the use of cloud computing. Thus, cloud computing and Internet of things can serve as a basis for smart cultural heritage.

References

1. https://books.google.co.in/books?id=v6VyDwAAQBAJ&pg=PA283&lpg=PA283&dq=use+of+cloud+computing+in+heritage&source=bl&ots=S7jmvNVDnU&sig=sC93RR7dk39xr1xW9snrnEx0fpE&hl=en&sa=X&ved=2ahUKEwiy7aC23eHeAhUciXAKHWGIBqg4FBDoATAHegQICRAB#v=onepage&q=use%20of%20cloud%20computing%20in%20heritage&f=false
2. https://www.researchgate.net/profile/Antonio_Guerrieri2/publication/269297922_Integration_of_agentbased_and_Cloud_Computing_for_the_smart_objectsoriented_IoT/links/54a126dd0cf267bdb9017f80/Integration-of-agent-based-and-Cloud-Computing-for-the-smart-objects-oriented-IoT.pdf
3. https://compass.ie/wordpress/media/Cloud-computing-infographic.png
4. https://www.informit.com/blogs/blog.aspx?b=a61c827f-f2b6-477b-9878-0fd45239c1a4