Towards Ubiquitous and Actionable Augmented Reality Browsers by using Semantic Web Technologies

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Abstract. In this paper we describe the preliminary results in the context of PhD thesis work which expands the PROINCE C231 2020-2021 project Voice Commands and Face Recognition for Augmented Reality applications. Our work aims to develop a framework to assist users to do their daily tasks through the creation and exploitation of reusable procedures for AR apps using the ontology of our research. In the second instance we aim to contribute to actionable and interoperable data sources using semantic web technologies where apps consume data regardless of the application that generates them. This paper will explain the basis of the experimental framework and the preliminary design of a web service called Semantic middleware that performs all the semantic operations necessary to make procedures interoperable with other third-party applications using Semantic Web technologies

Keywords: Augmented Reality, Semantic Web, Linked Data, Linked Data Cloud.

1 Introduction

Augmented Reality (AR) adds virtual elements to the real environment, enriching the perception of reality with virtual information [1]. In recent years, AR has expanded to different application fields such as education, healthcare, industry, tourism, marketing and entertainment. Currently there are several popular augmented reality browsers (AR Browsers) on the market such as LayAR[2], wikitude[3] to provide augmented reality experiences. These are limited because they allow users to passively consume a delimited set of functions. Different alternatives were researched like ARCAMA3D [4], T. Matuszka et. al. [5] y SmartReality [6] which offer a ubiquitous experience through integration of semantic web technologies to add information from the Linked Data Cloud [7] to enrich the description of point of interest near the user position. Although these applications allow the creation of contents, they are consumed statically. In other words, they can only be applied to view descriptions without being able to perform any

action on them. However, it is useful for users to have a dynamic interaction with the contents available through the definition of procedures composed of a set of actions to be performed in an environment enriched by augmented reality. In this order the presented framework is positioned in the interception of the areas of Augmented Reality browsers, users, and ontologies (Semantic web) (Figure 1), providing a dynamic interaction (DI), through interoperable procedures about augmented objects using AR applications and semantic web technologies. These capabilities will impact in several areas in Industry 4.0 contexts, such as the creation of a sequence of tasks to be performed by an intelligent operator in his workstation in a Smart factory, in the augmentation of tasks to be done with an IoT equipment of the plant or in augmented home devices integrations as well.

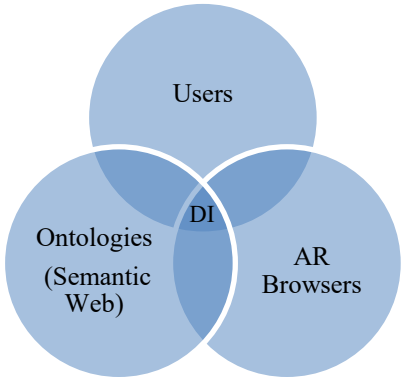

Fig. 1. Integration of knowledge areas

This paper will explain the basis of the experimental framework and the preliminary design of a web service called Semantic middleware that performs all the semantic operations necessary to make procedures interoperable with other third-party applications using Semantic Web technologies.

2 Framework

This work aims to develop a framework to assist users to do their daily tasks through the creation and exploitation of reusable procedures for AR apps, using the ontology of our research. Secondly, it is aimed to contribute to actionable and interoperable data sources using semantic web technologies where apps consume data regardless of the application that generates them [8]. The general architecture is divided in three parts: A Procedure editor, a semantic middleware, and an Augmented Reality Browser (Figure 2). The procedure editor will allow content creator users to create and edit procedures composed of a set of steps/actions to be performed in the physical environment, using augmented reality technologies. Each step can involve object manipulations, so the editor will allow to search and relate data about that objects from Liked data cloud if it is available. For this task data will be mainly fetched from DBPedia [9]. Semantic

Procedure Editor will allow procedures to be associated to virtual catalogs thanks to the Semantic Augmented Catalog System service, through a semantic layer which will apply our ontology "Semantic Catalog System Extension Ontology". In Addition, the semantic editor of procedures will allow our augmented virtual catalog system [10] to be an interoperable data source with the framework proposed as a doctoral thesis work. The use of semantic technologies will allow other augmented reality applications to consume procedures and discover augmented virtual catalogs for integration and exploitation on their platform for their own purposes.

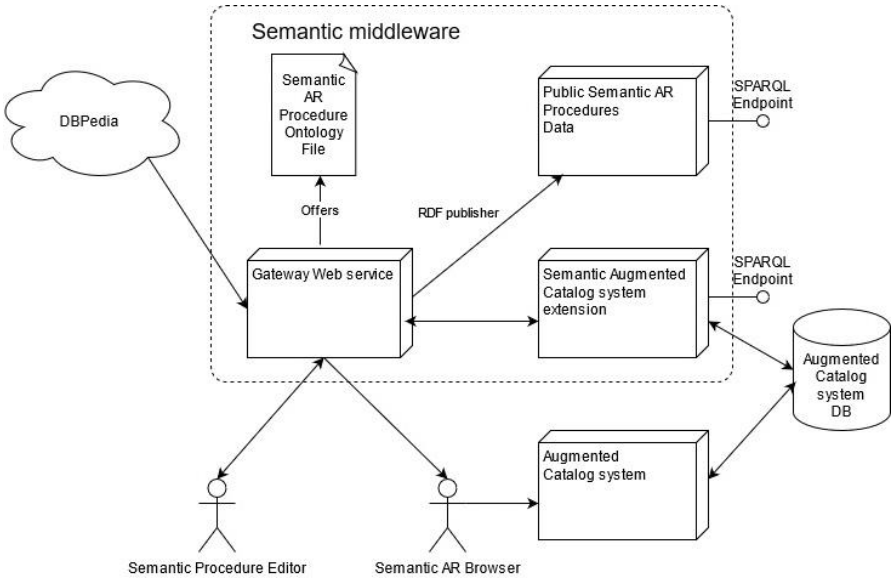

Fig. 2. Conceptual architecture of the framework

The semantic middleware is composed of a main web service called Gateway web service that has as main responsibilities to maintain the Semantic Augmented Reality Procedures ontology and to be the entry point of requests for the creation of procedures and search of procedures to be added by the augmented reality browsers. A RDF triplestore acts as a Public Semantic AR Procedures data service that is responsible for storing the procedures created and providing a SPARQL endpoint so that other applications can consume the data generated by the system. Finally, the Semantic Augmented Catalog System extension service that as mentioned above, works as the semantic layer of our augmented catalog system.

At the time of procedure creation, the gateway web service works as a mediator between the editor and the RDF triplestore (Public Semantic AR Procedures data service) to store the created procedures. In Figure 3 we can observe in a sequence diagram, when the Gateway web service receives the created procedure, applies the ontology from our research and redirects this structured data to the triplestore for its corresponding storage for later search and consumption by the augmented reality browsers.

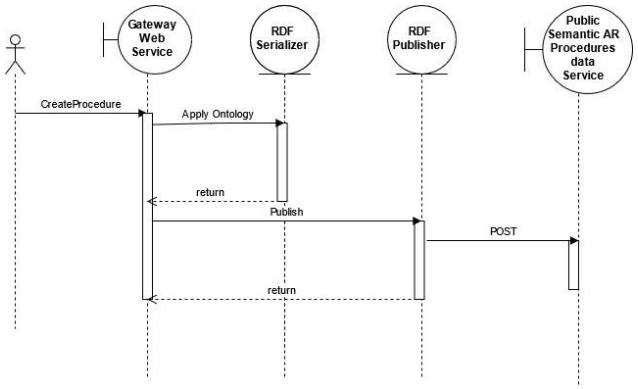

Fig. 3. Procedure creation sequence diagram

3 Conclusion

The present paper presents general architecture of the framework and the preliminary design of the semantic web service that will allow users to incorporate linked data in their daily actions through the use of augmented reality browsers in their real physical environment, allowing to generate specific procedures for the physical instruments to be augmented; this last capability concentrates the main contribution of this paper, allowing a new way to exploit the augmented content, where the user interacts dynamically through procedures that are interoperable with other augmented reality browsers using Semantic Web technologies.

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