Architectural Support for a Sustainable Service Environment in Smart Gallery*

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Abstract. We propose a software architecture to support a sustainable service environment based on a content ecosystem in a smart gallery. To continuously enrich contents, the proposed architecture presents spatial contents over physical objects, allows users to generate new contents by extending the contents and enables them to selectively share contents in real-time through a server. The proposed architecture also enables the generated and shared contents to behave intelligently, based on a layered response structure, by exploiting contextual information about users and their contexts. We demonstrated how the architecture realizes and encourages a content ecosystem through a poster exhibition as a part of art gallery guidance. Therefore, we expect that the proposed architecture will play a vital role in building multimedia service environments empowered by a content ecosystem.

Keywords: Pervasive computing, mixed reality, context-awareness, sustainable service environment

1 Introduction

Aided by an increasing number of studies on the convergence of virtual reality and ubiquitous computing, smart spaces have been continuously evolving for meeting users' desires. Pervasive and ubiquitous computing resources in our daily lives have been changing how we interact with environments in various ways [1]. Furthermore, the Web 2.0 paradigm has guided the Internet service environment in a new direction by giving users more control in creating, sharing, and using contents. The Cross reality have tried to connect virtual space and physical space by sharing sensory

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information [2]. Therefore, it is important that the convergence of virtual space and physical space and the participation of users change our smart spaces since the service environment has continuously extended and evolved.

To make a content pathway between the two realms, we define a content ecosystem in a mixed reality space and propose software architecture for supporting the content ecosystem that allows users to generate, share, and reuse the content based on the combination of augmented reality and context-awareness. We then display a poster exhibition to show how the content ecosystem is formed and used in tour guidance.

2 Content Ecosystem in the Convergence Space

We first define a content ecosystem in a mixed reality space where content is created, shared, and used. The content includes various types of information such as images, text, sound, photos, and 3D virtual models, all of which are commonly used in the Internet environment. Originally, service providers generated the content, but recently part of it has been generated by user participation. End-users use the content overlaid on various types of objects in the real world. However, in the proposed content ecosystem, content is continuously created, shared, and reused. Users generate content over real objects anywhere and at any time by exploiting physical space. The generated contents are also shared among other users in real-time. Social relationships and contexts contribute to building an instant community, and content is distributed to relevant users through a shared content manager. The content is used for interaction or for creating new content or services.

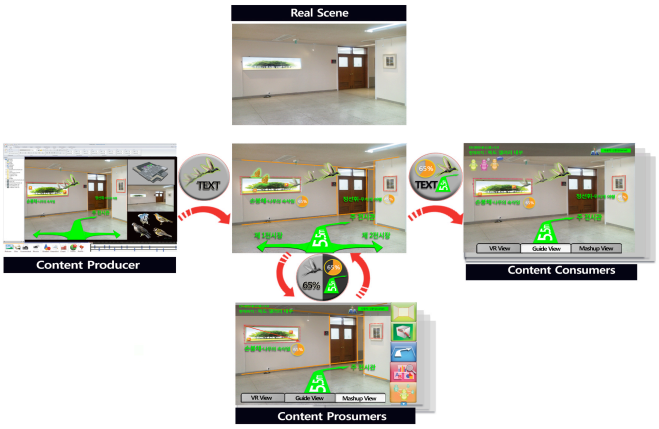

Fig. 1. Content ecosystem in the convergence space.

As shown in Fig. 1, the ecosystem is maintained by the contributions of producers, consumers, and prosumers (producers and consumers) in the content ecosystem. The producers provide basic and required content for users at a given time and the consumers use the content. The prosumers take on the roles of both the producers and the consumers. They not only use the content associated with the real environment,

but also create new content and services by extending and combining the existing content. Lastly, the consumers interact with the content based on their preferences.

3 Software Architecture for Supporting a Content Ecosystem

In order to support the content ecosystem, we propose software architecture for supporting a content ecosystem that is composed of a dual space manager and an authoring platform. The dual space manager stores, provides, and distributes content to users and thus plays a role in connecting users with content. The authoring platform allows users to generate, share, and reuse the content in a real environment. It thus gathers and analyzes sensory data and infers a high-level context, based on the collected data. It also recognizes and tracks objects in the real environment with contextual information and tracking algorithms. The platform then determines, customizes, and presents appropriate content according to the context and geometry of the real environment. Furthermore, it allows users to generate and mash up content with real objects using relevant content from the Internet and the dual space manager.

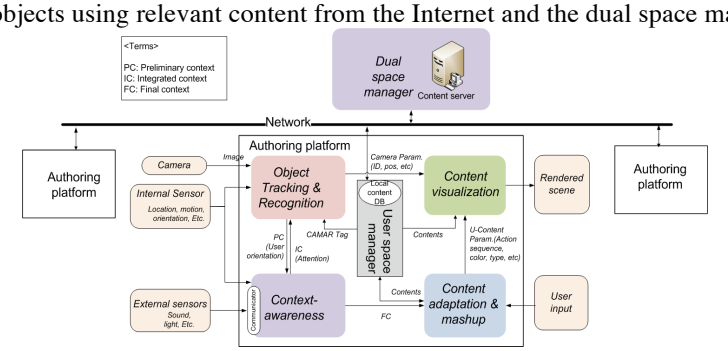

Fig. 2. Software architecture for supporting a content ecosystem.

As shown in Fig. 2, the platform obtains relevant content from the dual space manager, based on the user's context, which describes location, nearby objects, and preferences. It then overlays the real objects with the content for further interaction. It also allows users to generate content by extending it and adding new information over the objects to express their opinions and give feedback. The content is uploaded to the dual space manager for sharing among other users when the user makes the content public. Therefore, the content can be continuously generated, shared, and reused in a mixed reality space based on the proposed software architecture and thus used to form and maintain a sustainable multimedia service environment.

4 Implementation

We implemented the proposed architecture by imposing a content ecosystem in a mixed reality space. The authoring platform was implemented in two ways: for a desktop authoring platform and for a mobile authoring platform. The desktop

platform was implemented with Microsoft Visual Studio 2008™, supporting various types of detailed content authoring for an expert. The mobile authoring platform was implemented with Windows Mobile 6 SDK on a Samsung Omnia and used for a consumer and prosumer. The dual space manager was implemented with MySQL for managing content and with Open Scene Graph (OSG) for visualizing the content. It also supported an HTTP connection for uploading and downloading content from the authoring platforms.

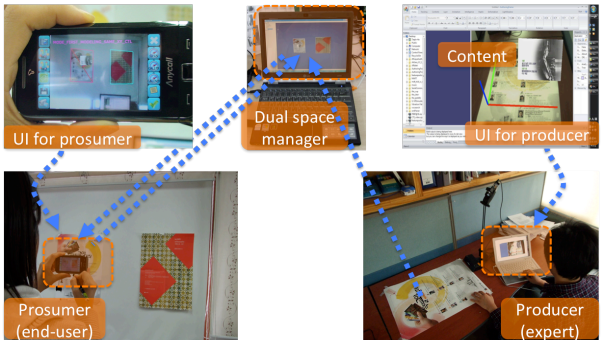

Fig. 3. Content ecosystem in a poster exhibition.

We then applied them to a poster exhibition as part of a common art-gallery guide application. As can be seen in Fig. 3, users form a content ecosystem in the poster exhibition. Initially, the service provider attaches content to a poster as part of the guidance information. The content is then stored in the dual space manager. The end-user with a mobile device retrieves and downloads the content associated with the poster from the dual space manager. The end-user also extends the content by attaching new content in his or her mobile device or by mashups with other databases.

5 Conclusion

In this paper we have proposed software architecture for supporting a sustainable service environment based on a content ecosystem in the convergence space. For this purpose, the proposed architecture allowed users to generate, share, and use the content by presenting it in a real environment. We also implemented the software architecture and showed a poster exhibition as an example of the content ecosystem.

References

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