Augmented Reality Dissemination and Exploitation Services for Libraries

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Abstract: In this work we present a prototype mobile augmented reality system that promotes the dissemination and exploitation of a library's content and services. The system creates an engaging and immersive ecosystem enhancing the leisure experience for library visitors, allows users to create augmented reality content while visiting the library and attempts to offer personalized services targeting to library visitors' needs. Visitors are able to purchase a personalized digital version of a book, with respect to the book's copyrights, thus generating revenue for the library.

1. Introduction

Applying Augmented Reality (AR) solutions to the libraries domain is a recent trend following the advancements of AR technology. Many excellent applications have been used in libraries around the world providing AR services like real-time library navigation or book information augmentation (Vidlund and Petersson (2014); Chen, Tsai, Hsu, Singh and Girod (2011)). The next step towards a sustainable library environment is the use of AR in the commercial exploitation of library's content and services through the use of existing or future mobile equipment. The intervention of mobile-based systems with libraries management is a challenging field, as it can raise awareness to the broad public and provide digital solutions to libraries personnel (Fernandez (2017); Shatte, Holdsworth and Lee (2014); Varnum (2017); Zak (2017)).

Our contribution to the field of digital library management is a system that integrates engaging, personalized and immersive dissemination services to the visitors of a library, while offering novel exploitation opportunities for the institute. The design and implementation of the system's AR services is based

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on a user-centered strategy which requires a deep comprehension of the library visitors needs (Marchionini (1995)). The system uses AR services to enhance the user experience (UX) during a library visit in order to engage the user and prolong the visit's time and help the user to personalize the reading of a book. Moreover, the system offers an opportunity for the library to generate revenue by providing users the capability to purchase a personalized digital version of the physical book, with respect to each book's copyrights.

2. Related Work

Hahn, Ryckman and Lux (2015) introduce an ecosystem for developing recommender apps with AR services and present a specific app that is able to recognize call numbers on a book in the library and suggests relevant items that are not shelved nearby. A mobile AR application for book spine recognition on library shelves is presented by Chen, Tsai, Hsu, Singh and Girod (2011). Vidlund and Petersson (2014) in Geolocations app offer an AR environment with which users can scan the Uppsala city and navigate to ten different library buildings of the Uppsala University. Moreover authors explore the use of AR services as a marketing tool.

3. The System Design

The system design consists of three parts: the local server (LS), the management application (MA) and the AR application (ARA) as illustrated in Figure 1.
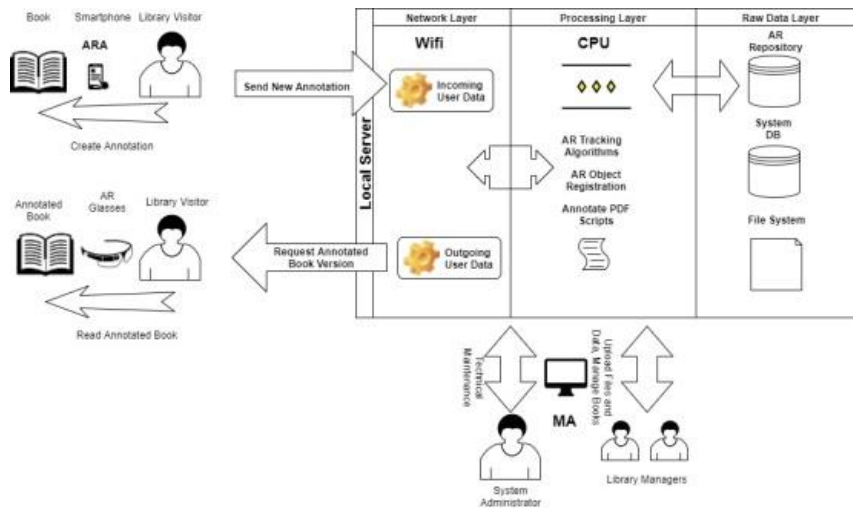

Figure 1. System Design.

The basic idea behind system operation is that library visitors use the ARA installed in their mobile devices to submit AR annotations, associated with specific pages/phrases of the book they are reading, to the LS. The LS collects

each annotation, tracks the exact position where the user wants to embed an annotation, embeds it to the digital version of the physical book (pdf) and stores the new annotated digital book version. When the user requests to view the annotations of a specific phrase, the LS sends content to the user's device.

Annotation Service: The AR annotation service implements specific steps until an annotation is ready to be displayed to the user, through the ARA. Annotation creation is initiated by focusing the device on a book phrase and taking a clear picture of that phrase. Through a form, on a user-friendly modal window, the user submits annotation information like the book title, page, page row, annotation text and characterization (personal or public). The system consumes the user annotation and creates a personalized digital book version, hosting the new annotation at the desired position. Moreover, the system keeps the captured image of the book phrase to the AR Repository in order to be able to perform the AR tracking operation using the image as a target. When the user focuses her/his mobile device's camera on the book excerpt, the ARA uses the user-created image to track the location that the AR element (annotation) will be registered. The ARA achieves the image target tracking by analyzing the contrast based features of the target image that are visible to camera. After the successful tracking, the ARA retrieves the stored annotation text tied to that image target and registers the annotation to the right position. The registered AR element is a modal window that hosts the annotation text, embedded in the camera view over the book phrase that the user focuses on.

Purchasing Service: Registered users can purchase the personalized digital version of a book. Purchasing policy is defined by the copyrights of each book.

4. Implementation & Evaluation

In order to develop the ARA we use Unity 2017.3 (2017) and Vuforia 7 (2017) platforms targeting Android 4.4+ mobile devices. Visual Studio Emulator for Android (2017) was used for testing. All system modules are developed and tested on an Intel core i7-2600, 8GB RAM at 1866MHz Windows 10 machine.

We perform a first system evaluation (CON) comparing it with 3 digital library management systems, based on the offered AR services, the Geolocations app (GEO) in Vidlund and Petersson (2014), the recommendation app (REC) in Hahn, Ryckman and Lux (2015) and the book spine recognition app (SPI) in Chen, Tsai, Hsu, Singh and Girod (2011). Evaluation results are demonstrated in Tab 1. All 4 applications disseminate their services to the broad public by trying to improve the user experience (UX improvement criterion) of library visitors. CON and REC provide personalized services to library visitors. CON is the only one that offers the opportunity to library visitors to create personal AR content, while the GEO and SPI allow AR content creation by the library staff. In a technical level, CON and SPI implement image based AR tracking while the GEO uses QR codes and the REC barcodes. CON, GEO and SPI offer both AR

content registration and viewing while the REC does not display AR content. AR content can be accessed through mobile devices (smartphones, tablets) in all 4 systems. Finally, CON is the only one that offers real exploitation services while GEO only aims at promoting and marketing a library's services and content.

Serv./Sys.	CON	GEO	REC	SPI
UX Improvem.	X	X	X	X
Personalization	X		X	
AR Creation	X (v)	X (st)		X (st)
AR Tracking	Image based	QR codes	Barcode	Image based
AR Registrat.	X	X		X
AR Viewing	X	X		X
Mobile Devices	X	X	X	X
Exploitation	X			

Tab. 1: System services comparison table

5. Discussion & Future Work

Collateral benefits accrued from the usage of our system consist of interesting post-retrieval activities such as the acquisition of user profiles and interests. For our future steps we will install and test the system in real conditions and work towards a fully automatic annotation procedure.

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