REFF book as a Mode-2 learning platform

Luca Simeone[1], Salvatore Iaconesi[2], Federico Monaco[3],

[1]Malmö University, Malmö, Sweden and FakePress, Rome, Italy
[2] FakePress, via Ghislieri 17, 00173 Rome, Italy
[3] University of Parma, Italy

{luca, salvatore}@fakepress.net
federico.monaco@nemo.unipr.it

Abstract. This paper explores augmented reality as a set of technologies and processes that weave hypermedial content into printed publications thus fostering new educational practices. The idea was to implement a platform fostering what has been defined as 'Mode-2' knowledge production practice. This is a practice that involves multi-disciplinary teams, brought together for short periods of time to work on specific, complex problems in the real world. In particular this paper focuses on augmented reality as a bridge to extend traditional hypermediality to paper-based educational tools, analyzing as case study a book recently released by the Italian publisher FakePress. The book addresses the concept of remix as a political and educational practice and is based on an extensive use of QR codes and fiduciary markers that act as triggers to retrieve and show additional content published by both authors and readers through an open CMS (Content Management System). The QR codes and the fiduciary markers work as links to hypermedial remixes that extend the limits of traditional educational text books.

Keywords: augmented reality; enhanced learning; on-line collaboration; Mode-2 knowledge production

1   Introduction

This paper delves into augmented reality as a set of remixing practices to weave hypermedia into printed publications thus bridging physical and digital worlds [1]. In particular, it focuses on educational potential of augmented-reality hypermedia, both as a tool to enhance paper-based books and as an educational practice based on social constructivist theories.

The paper presents an educational project based on an augmented-reality-based hypermedia book recently published by FakePress (REFF Book). This book is connected to an open digital platform (CMS) and both authors and readers can use it to publish hypermedia content and to tie it to specific locations of the book. The REFF Book was tested as a text book for a university course in Interaction Design at

the University of Rome where the students actively utilized the CMS as a tool to tinker and experiment with augmented reality thus developing theoretical and operational competences on remix practices. The paper presents the preliminary results of this educational project, even though it is still at an early stage and a more thorough analysis is needed to assess the actual educational potential of such approach and technologies.

The project is based on two different dimensional backgrounds. The first one focuses on the impact of OER (Open educational Resources), their accessibility of contents and materials, as asynchronous and distance learning objects. The second one relates to the Mode-2 knowledge production [2-3] standpoint, which represents an updated model on how knowledge flows between science and society, not considered anymore two separated realities, but as entangled by interests, values, priorities; science itself becomes therefore context-driven, problem-focused and interdisciplinary. Both OER and Mode-2 knowledge production approaches informed the development of the hypermedial book and the overall background of its collaborative/educational project.

2 Related Work

The examples here considered deal with the multiple meaning of the term augmented press:

1. The paper version of a hypertext;

2. A paper book or a magazine incorporating hypermedia;

3. An interactive experience for the reader mostly based on augmented reality technologies.

Several AR-enhanced educational text books have been recently published and presented [4-5]. Common AR applications for books often consist in virtual objects popping up from printed papers into smart devices screens [6] or in (somewhat) re-engineered physical books such as in the Digilog project [7].

Augmented reality is a trendy technology and new applications of AR-enhanced educational paper books are usually reviewed both by scientific community and mainstream media [8-11].

Expanding the limits of paper books also means crossing over the spatial physical boundaries of the printed page: location-based media allow another extension of the narrative forms that can start from the pages of a book and get spatially re-articulated into responsive architectural forms [12].

Several scholars such as Dede, Klopfer, Barab, Dunleavy offer a deep theoretical grounding for augmented-reality-enhanced educational practices [13-18]. A common theme emerging from their analysis is the students' active engagement into an immersive environment that fosters multiple perspectives and favors knowledge transfer.

Based upon this theoretical approach, FakePress created REFF Book, an augmented-reality-based educational printed book exploring the themes of cultural remix.

3 REFF Book

REFF Book [19] chronicles the intense experience of REFF (the RomaEuropa FakeFactory) told through the contributions and works of the wide network of artists, intellectuals, journalists, teachers, lawyers and activists who participated. RomaEuropa FakeFactory [20] was an act of *artivism* in favor of free culture and non-proprietary rights for authors. This network confronted the themes of art and hacking, political activism and technology, copyright and intellectual property, cultural politics, crowd sourcing, open source models, peer-to-peer economic governance. More specifically, REFF was an act of *détournement* and cybersquatting against the policies for management of intellectual property rights of an art competition sponsored by Romaeuropa Foundation and Telecom Italia. This competition was based on very controversial policies that for example did not allow the use of remix in the artwork. REFF network decided to create a parallel competition, actually squatting the website and the official corporate identity of the official art competition. The motto behind the parallel art competition created by REFF was:

"Remix the world! Reinvent Reality!"

and of course it did welcome any artwork based on remix, one of the principal themes that has inspired the REFF. It was followed by the presentation of REFF's instances and methodologies to the Cultural Commission of the Italian Senate (Commissione Cultura del Senato della Repubblica Italiana), up to the current production of the REFF book, as a global effort to create a working business model that implements the concepts and demands expressed by the RomaEuropa FakeFactory.

All these themes are addressed in the REFF book both at a theoretical level (in the essays published in the first part of the book) and through a performative layer based on augmented reality. In this sense, the REFF experiment is more than its content and traces new possibilities for publishing. The book comes fully integrated with a digital dimension through the use of QR codes and fiducial markers. These tools transform the experience of reading, enhancing it with an interactive dimension. The software is deposited on paper as hypertext / hypermedia, making it clickable, expandable and reactive, opening a virtually unlimited space for discussions between authors and

readers on issues and debates on the book, dissolving the traditional boundaries that separate them. This book also develops a new prototype for the intersection between digital and paper dimensions and, thanks to a special application, is available on the web, or via iPad or smartphone as ubiquitous and cross-media publishing.

The book begins with the section "VOICES": a collection of more than 30 theoretical works on the themes of Free Culture, remixing as creative practice, the re-contextualization of urban spaces and knowledge sharing from international scholars such as Richard Barbrook, Andy Cameron, Stephen Kovats, The Yes Men, 0100101110101101.ORG, Jasmina Tešanović, Massimo Canevacci Ribeiro, Antonio Caronia.

A catalog of the artworks presented by 32 artists, writers, designers, hackers and architects from all over the world follows in the section entitled "VISIONS". These contributions give a voice to the unexplored scenarios of contemporary reality representing the worlds of innovation, appropriation and a continuous artistic and political reinvention bringing to light examples of new production models based on freely available contents, knowledge, connections and the possibility of reproducing, remixing and arranging contents, forms and objects, new technological practices, new forms of social interaction, new opportunities for building unedited, self-determined imaginaries.

4 REFF Book Platform

QR codes and fiducial markers are integrated graphics on the pages of the book and can be used to access a stratified multimedia publication filled with contents and representations. At the same time, QR codes act as measuring mechanisms that register the number of users that access each hypermedial section of the book. In short, QR codes and fiducial markers function as a tool for publishing and tracking purposes allowing:

- the authors to expand their contributions to the book by adding notations, new sections, multi- and trans-media objects, in an open-ended process thereby overcoming the limitations of time, space and size of the print publication;

- the readers to comment and interact in dialogical processes with the authors (and other readers), creating parallel meta-narratives;

- the editors to track stories and biographies of the users of the book, examining and recounting patterns of use of the book.

The content is accessible using the latest mobile technologies and through the book's website. A free application downloadable on smartphones (Symbian, Android and iPhone) or PC (Windows, Mac, Linux) is available to readers on the book's website so that they can develop and benefit from the augmented reality elements and tracking tools.

The QR codes allow readers and authors to access the enhanced augmented reality contents as well as launching a CMS platform to express their comments on both the contents of the book and their views on the themes covered. By using these publishing tools, each reader is free to publish their own media-related texts on a URL tied to the QR codes making them accessible to the other readers, as well as to the authors and the publisher.

Everything is presented as a constantly transforming mix of multi-authored contents, freely accessible, continuously updated and amended over time and potentially giving rise to strange, unexpected experiences: a reader could post a comment or a contribution that gains more attention than the original author's work, driving more visits and reviews of that section of the book. The book itself thereby works as an activator of dynamic and practical narratives and dialogues which call into question the hierarchies of authority and credibility among editor-author-reader, re-negotiating the traditional boundaries and limits.

The tracking tools allow for the creation of supplementary meta-narratives. Before accessing the contents linked to the QR codes, users (readers) are asked to fill out a short survey including the following fields:

- Name / nickname
- Date of birth
- Where / from whom you received the book

Each QR code (and related content) allows users to express their satisfaction (even in the form of emotions evoked during reading/use) and with the data collected through the mechanisms identified above, as well as system analysis of access logs to the urls called from the QR codes, additional content can be created in the form of info-aesthetics. These real-time dynamic visualizations show some processes (or meta-processes) of the book, such as:

- the geographic distribution of readers with the ability to view the book's movements (e.g. Luca, in Rome, has lent the book to his Swedish friend, who then passed it on to ...);
- rankings on the most read, viewed or commented passages that have generated interest in readers;
- conversation vectors: who interacted with whom and how often (both among authors and readers);
- a mapping of the users' emotional reactions updated in real-time (emotions triggered while reading the book);
- time of use (what time of day or night the book is read / received);

 demographics of the readers which open the possibility to tracking trades and loans of the book (e.g. the age of those who buy it first and the ages of those who receive the book as a loan / gift).

These kinds of book-analytics feed the dynamic infoesthetics generated by the system and accessible to all readers via QR codes. Some fiducial markers in the book also launch three-dimensional views of this data and information, almost becoming a physical representation, an incarnation of the book as processing element. As with pop-up books for children, the 3D visualizations become information carriers (dynamically updated in real-time) capable of showing the patterns of use of the book: 3D architectures continually generated and regenerated from the practical use of the book.
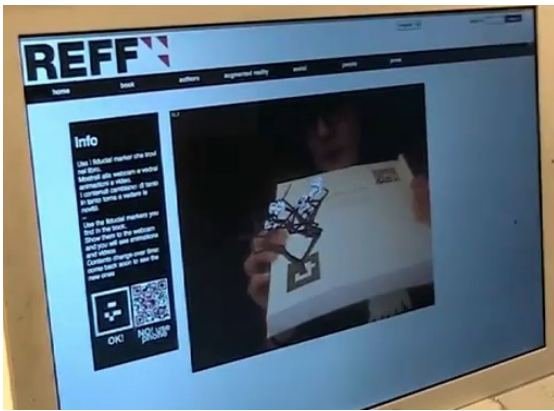

Fig. 1. Fiducial markers showing real-time 3D representation of patterns of use of the book.

5 REFF Book in use

In the first months of 2011, REFF Book was used as a text book for the course in Interaction Design at the University of Rome, La Sapienza (Faculty of Architecture).

In the initial chapters, the book presents a theoretical account of augmented-reality as remixable hypermediality. The second and third part of the book are filled with QR codes and fiducial markers connected to a CMS. All the students, working in groups, were granted an access to the CMS and invited to actively use it to publish their own hypermedial content and tie it to specific markers printed on the book.

The CMS acts therefore as a training arena for making experiences of contents and relations with other contents upload by other participants. Remixing practices were possible on CMS where contents can be handled and transformed adding new contents to the existing in very creative ways. The versatility of CMS anyway is not enough; users' intentionality and representation of CMS useful to their learning needs are of concern.

The digital platform behind the REFF Book – in particular the CMS – works then as a more performative interpretation and account of the concept of remix, the main theoretical theme behind the book. The CMS itself allows authors and readers to create their own remixes thus putting in practice what the book stresses in its theoretical part: the vital importance of remix practices for digital cultures, art, political activism, hacking.

The CMS is therefore one of the core elements of the system as regards its educational potential.

The first testing sessions of the book – at La Sapienza, in Rome – showed that the students felt a high-level of active engagement while using the CMS. The students felt challenged by the creative possibilities offered by the interface. Moreover, the students had to plan, find and select the content they wanted to add to the book. Through this process they not only refined their skills with the platform, but they also developed important meta-skills related to more traditional publishing (and communication) processes (selecting, packaging and distributing information).

Our educational purpose was to set up a learning environment where students could actually explore augmented reality (and the themes behind the book) in a non linear, 'designerly' way, therefore through a process of tinkering and iteratively testing and modifying the final AR-enhanced artifacts. In this sense, our project fosters an educational philosophy close to what has been defined 'Mode-2' knowledge production. 'Mode-2' has a strong operational component and is partially connected to the constructivist idea that the knowledge is not transmitted directly from one knower to another but is actively built by the learner often through an active process of construction [21]. Whilst the students were tinkering with the CMS and exploring the concept of remix, the REFF book was already available in bookstores (in its Italian version) and therefore the content published by the students was immediately available to all people who bought the book. Readers who bought the book in the bookstores could access, visualize and comment the content created and remixed by our students. This created a dialogic flow that went across the traditional borders of our classroom. Several streams of productive conversations stemming from the themes behind REFF started (political activism and technology, copyright and intellectual property, cultural politics, crowdsourcing, open source models, peer-to-peer economic governance). The students had to engage in these conversations continuously remixing and re-articulating their content through the CMS. These knowledge flows moving across different layers (academia, external readers of the book, artists and activists who participated to the REFF project) truly embodied some Mode-2, transdisciplinary and cross-contextual dynamics.

Another crucial educational component was the classroom collaborative environment we tried to set up. Students were working in groups and shared the CMS and the books. The collaborative dimension of the process further enriched the educational component of the project [22].

Finally, on a more personal side, this process was also important because it gave us some feedback on the GUI of the CMS. Although in the design phase we tried to adhere to strict accessibility and usability principles, the users' work through the CMS showed some critical elements and areas of improvement.

6 Future Work

The main objective of the first phase of this research project was to build a prototype of the application and this milestone has been achieved. The project has been tested for the first time in a real education environment, but only across a short period of time (few weeks) and on a limited number of students. The qualitative research methods applied during the test (mostly participant observation) gave us some first important feedbacks as regards the user interface usability and these elements will be the starting point to refine the application and to prepare it for a larger, open-source distribution. A thorough analysis on a larger scale and based on quantitative research methods is needed to assess the actual potential of this platform.

7 Technology

The REFF book was built using FakePress' "Multi-Author Cross-Media Ecosystem" (MACME) CMS. MACME was developed as an open standard, pluggable, multi-author, cross-media Content Management System.

The MACME platform allows publishers and authors to generate their own location-based, AR-enhanced publications and to format and optimize them for print and digital distribution (for use with most e-book readers).

- Open Standards: MACME uses only internationally accepted standards whose definitions and scope are independent from manufacturer-specific constraints. The system acts as an integration layer among software components which implement open protocols, formats and technologies and makes them available across a multitude of platforms.

    ☐   Multi-author: a specific focus has been put into making MACME a tool for the expression of multiple voices being able to collaborate across languages, cultures and technical capabilities.

    ☐   Cross-medial: the main idea driving MACME was the possibility of creating a platform that would allow contents to be made available across multiple media in ways that were optimized for each specific case: for example the possibility of hosting the same video on a web page (under the form of an interactive control), on a smartphone (using a small software component), on a paper publication or on an object (using a QR code or a Fiducial Marker if we wish to see it using Augmented Reality techniques). MACME allows authors to add media to their publications and simply specify on which kinds of outputs they would like to make it available. The platforms create the technical infrastructure needed to accommodate their choices.

The specific MACME implementation used to create REFF Book was built on top of a multi-user Wordpress system, implementing a logical architecture. A customized Graphical User Interface (GUI) allows authors to create their content. Typical editorial content is created using widely known Wordpress functionalities (a WYSIWYG editor usable to create formatted text, images, videos...). On the same interface special cross-media contents can be added in accessible ways. These generate specially formatted XHTML constructs that are interpreted by the Renderers to produce them in the most appropriate formats for each output. A Template Engine is used to personalize the aesthetics of the various outputs using a CSS based approach. An open API allows for the creation of additional content formats: contents can be tied to data sources, web-searches, image/video databases to create interactive experiences, info-aesthetic representations and visually browsable databases that can be used along and inside articles and that will be correctly accessible from any platform. In the REFF Book, for example, authors particularly enjoyed linking their articles to interactive interfaces generated by performing real-time web and image searches on the themes of their contribution, thus creating articles that would self-update with the most relevant information available at the time of writing, even years after the publication date.

8 Conclusions

Although still at an early stage, this research project shows promising directions to enhance current teaching practices using AR-enhanced paper books. An educational environment based on empowering systems (CMS) that allow users to publish (and remix) their own AR-enhanced, hypermedia content seemed particularly effective to convey some theoretical and practical knowledge on the themes covered by the book (remix, digital culture, hacking, digital activism). Moreover, the constructivist education processes also helped the students develop soft skills (such as problem-solving, communication, working in groups, negotiating skills, planning and strategic

thinking...). The two dimensional development of OER and Mode 2 Knowledge production approach has been useful and effective on many levels. It supported developing students' soft skills and experiment remix practices, but also testing an open source environment where user is not defined and limited by designer's representation of user, but where designer and user may pursuit the same goal of recomposing the existing materials with new one in a very creative way. Such tutorial and collaborative practice may constitute an example for the development of tomorrow's learning environments where knowledge is expected to be constructed in networks and interdisciplinarity can make a further difference to learning processes.

As stated by several authors [14-16], augmented reality poses technological, managerial and cognitive challenges to teaching and learning. More rigorous research and testing processes are therefore needed to assess the actual potential of the platform on a larger scale, but we hope that the preliminary results of this research project serve as an encouraging starting point for further and deeper evaluations.

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