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The RocReadaR – a system for transmedia news publishing using augmented reality

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Abstract

We designed and tested a prototype of a system for collaborative publishing across different media platforms in the form of an application for smart personal Android-based devices. This system includes and uses a printed document (e.g. a magazine publication) as an entry point. The printed document is seamlessly linked to digital web-based material and collaboratively augmented by the users in an interactive fashion using personal computing devices. While the printed document stays the same, the associated virtual digital multimedia part is updated by the community of authors and readers and discovered by using image-based tags embedded in the printed document via augmented reality technology. We call this method of publishing transmedia publishing, since it has similar characteristics to transmedia storytelling. To demonstrate the feasibility and utility of the system we conducted a laboratory study where we asked student participants to use the system while reading a printed magazine and provide their evaluation of the quality of experience. The results of the experiments demonstrate that users on average preferred transmedia publishing over the regular printed magazine for its ability to provide compelling user experience and rich media content. They also emphasized an integration with social media and an option for uploading additional content as important advantages compared to print. The findings can be used to formulate design recommendations for implementing transmedia publishing system in practical real-life applications and to improve our prototype.

Keywords: transmedia, news publishing, print media, augmented reality technology

1. Introduction

It is widely acknowledged that the printing and publishing industries are undergoing tremendous changes complicated by rapid digital technology developments, the rising accumulation of knowledge and data on the web, and the ubiquitous use of personal electronic devices. During the last several years the place and role of web and digital media in publishing and communication grew exponentially, spurred on, in part, by instant access to vast web-based data sources, peer networks, social media, the availability of video and multimedia material, interactivity, and real-time modifications of digital media. At face value, this growth might seem to hasten the end of relevance for print media. Yet, many scholars and industry leaders continue to acknowledge specific advantages of the print medium, including physicality/tangibility, portability, and unique sensory qualities. The distinctive affordances of paper are not only related to its physical properties and, consequently,

actions of grasping, carrying, folding, manipulating, and writing, as noted by Sellen and Harper (2003). The paper has been shown to support collaborative work as a tool for managing and coordinating actions in a shared environment, as a medium for information gathering and as an artifact in support of discussion. Case and laboratory studies demonstrated that people use pen and paper to think, plan and organize the work (Sellen and Harper, 2003). Additionally, print media is associated with more effective reading comprehension and knowledge gain (Davidson et al., 2010; Mangan, Walgermo and Bronnick, 2013; Jabr, 2013).

Increasingly scholars and practitioners are exploring ways to incorporate print media and its benefits with digital products. Together, the unique affordances of the different media and their distribution channels are being successfully exploited in cross-media marketing

campaigns and transmedia “entertainment supersystems” (Kinder, 1991). However, despite proposals by Veglis (2012), there are few studies that test how transmedia can be used to engage traditional print news audiences. We hypothesize that traditional printed publications using transmedia storytelling approach could, potentially, find ways to engage audiences outside their

2. Transmedia storytelling

Transmedia storytelling, defined by Jenkins (2006) as “stories that unfold across multiple media platforms, with each medium making distinctive contributions to our understanding of the world” (p. 334), has largely been studied in the context of individual creative projects with emphasis on collaborative content and production (e.g. Freeman, 2014; Gambarato, 2014). However, as noted by Jansson (2013), the potential effects of transmedia stories are much broader. Until recently, the term cross-media was used to mean the same thing as transmedia (see, for example, Davidson, 2010). Now, however, there is a growing consensus that cross media refers to releasing the same or similar content across multiple media platforms (Phillips, 2012). Other terms, including mixed media or interactive print, are often used to point toward combining variety of media together to produce a single physical or interactive experience, rather than in reference to the process and content of communication, and as such can be

3. Transmedia publishing system design

The potential benefits of linking digital media while interacting with paper-based material to produce enhanced storytelling experience have been recognized since early 2000s. In particular, Vogelsang and Signer (2005) described “The Lost Cosmonaut” installation, a prototype of an interactive narrative environment based on digitally enhanced paper. It consists of a desk on which a user can interact with objects made of paper with a faint pattern of infrared-absorbing dots by using a special electronic pen developed on the basis of Anoto AB (2016) technology. This pen has a camera placed alongside the writing stylus. By pointing the pen at text or picture, the user can view video and animations, displayed on a separate screen, and listen to the audio. The audience is encouraged to write and draw with the pen, and the created content is captured and stored in the database for the later access, making the installation an open entertainment system that can grow through a collaborative effort. Norrie and co-authors (Norrie and Signer, 2005; Norrie et al., 2007) developed the EdFest system – a knowledge sharing environment for The Edinburgh Fringe Festival, the world’s largest international arts festival, and the underlying context-aware platform for mobile data manage-

ment. The system provides access to information about venues and events and allows tourists to enter and share reviews of events, as well as their views on local restaurants. The access is accomplished through the interaction with the digitally enhanced paper brochure and an electronic pen, similar to the Lost Cosmonaut. The Java-based platform utilizes a cross-media link server and an object-oriented framework for advanced content publishing.

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Recently, augmented reality (AR) technology received a significant attention as a tool to integrate digital and tangible media forms. Unlike in the early stages of AR development, when head-mounted displays were used to overlay virtual information over real world environment, the new versions of AR software for smartphone and tablets allow to easily link various digital media items with physical objects, including prints. Several companies (e.g. Metaio, Aurasma, Wikitude, Vuforia) released their implementations of AR software, and made software development kits, SDKs, available for custom application development. In a previous study we used Aurasma software for the experiment, where we asked participants to read short fictional stories pro-

duced and presented in several ways, including in electronic form, print, and paper with AR. We found that the latter method of reading that integrates paper and electronic mediums, significantly enhances user experience and interest level as opposed to just plain reading from print (Fedorovskaya and Yu, 2014), potentially leading to better comprehension and retention of information. This method of reading was on par and even slightly better, in comparison with interactive reading from the screen.

To explore further we decided to design an AR-based prototype of a collaborative transmedia communication system, the RocReadAR, and test its feasibility and usefulness, specifically, for news and information media, by creating and evaluating a limited implementation of the method as an application for the personal smart device. The designed system links three different media channels: printed publication, digital web-based information and social media with its collaborative capability of sharing and adding content. It can be characterized by several key features:

- a. it is print-centric – printed information is an entry point to the process of communication;
- b. it integrates print and additional digital content by linking digital data through image-based trigger;
- c. the digital content can be located anywhere on the internet or a secure server in the form of files, video, audio, web pages, images, 3D interactive models, etc. and can be easily updated, added or replaced;
- d. it is interactive – users can navigate to digital information associated with the print via personal devices (a smartphone, tablet or a wearable augmented reality device, where Google Glass could be an example);
- e. it is collaborative – users can contribute to the document creation by adding material, leaving their comments, photos, etc.;
- f. it enables a fluent and seamless switching between print and digital; between reading and contributing;
- g. it potentially transforms the printed document into one of the channels of social media.

Our system shares several key elements with what has been proposed earlier: they all aim to harness the strengths of paper where it is used as a starting point for the interaction; through the paper and an electronic device, users can access various digital media, providing therefore a basis for integrated media experience; and finally, the users can add to the content in some form that can potentially lead to the collaborative expansion of the story. For example, in our prototype, as in the EdFest mentioned earlier, the printed material is a starting point for the interaction, through which the user can access web-based digital media. Similarly,

there is a possibility for adding content by the users themselves, such as comments and reviews. The main differences between the EdFest and the RocReadAR are in the underlying technology and the interaction method employed: we use AR-based mobile app to integrate different media and to provide an interface for exploring and creating digital content on the server. Furthermore, social media such as Facebook, Twitter, Google+, etc. become accessible in the integrated communication, as well as the expansion of modalities for content delivery – 3D models and visualizations in addition to web pages, video, audio, text files and photos; and content authoring – video, photos, textual files. As the physical vehicle to carry the interaction with printed publications, we chose smartphones and wearables, as the next step, with the hope to make the system flexible and readily available for every user. This choice also allows the inclusion of objects in the physical and virtual environments in the process of storytelling in the future developments. Finally, the intended application space is different – we are interested in developing a platform for transmedia publishing and news communication and in the process, figuring out the necessary requirements to make it useful and appealing.

The concept with all these components in combination has not been implemented for news media communication, and we believe its characteristics, the unique interaction design and the ubiquity of smartphones and, potentially, wearable devices, can make this an attractive publishing platform for transmedia journalism and news publishing.

To build the prototype with the functionality that we deemed important, we used the Wikitude SDK, a software development kit for the mobile Android AR applications. We chose Wikitude SDK because the existing ready-to-use AR software systems that we evaluated (Aurasma, Metaio, Layar) did not provide multiple channel media integration and user interaction experience suitable for news publishing, at least at the time of the study conception and creation of the prototype.

We applied the user-centered design process with several iterations to develop a working prototype in the form of a smartphone application. The application aims to modify the reading experience of a news story published in a printed magazine by providing access to digital media content via the AR technology. Readers can view pictures, videos, and listen to audio and music when they scan the magazine, upload their own material, including photos, videos and text; provide feedback; and share information with friends on social media. The multiple media platforms employed in our system – print, web and social – contribute to the enhancement of the readers' experience by offering additional relevant content, the initial story extensions, and opportunity to interact and participate within the story. The above characteris-

tics are used to define transmedia storytelling. Hence, we call the method of publishing enabled by our system – transmedia publishing. To evaluate the viability of the proposed method, we address the following research questions: Does this method of publishing provide a desirable utility and an enhanced quality of reading experience? How does it compare with the traditional reading of the news magazine?

4. Method

4.1 Participants

The study was conducted in the Discover Lab at the School of Media Sciences at Rochester Institute of Technology in Rochester, New York, during the 2014–2015 academic year. Student participants were recruited via flyers and an on-campus email. Twelve male and twelve female RIT students in the same age group (18–26 years old) participated in the experiment. The participants were screened prior to the experiment to ensure the same level of familiarity with the augmented reality concept. They had normal or corrected to normal visual acuity.

4.2 System prototype and materials

The system prototype tested in this study was implemented as a mobile application for an Android Nexus 5 smartphone. The application was developed using the Wikitude free trial Android SDK (Wikitude.com), available at the time of the experiment, which allowed to link digital content with the printed material.

In our RocReadaR system, the publisher provides page images which are annotated with additional content using a web application that we created using php, html and MySQL. The page image is characterized by a signature or ‘tracker file’ created by the Wikitude studio stored on the web server.

The Android application uses the Wikitude SDK to analyze images coming from the phone’s camera and compares them against the tracker files on the web server. If a match is found, a control button is enabled which provides access to the page annotations stored on the web server. These steps are illustrated in Figure 1 and 2.

To inform about the availability and to access various digital content we implemented touch icons (control buttons) on the user interface for video, audio, web information, and 3D animation. The subsets of these icons appear on the interface only when the corresponding media content is linked to the page and mapped in the server database (see Figure 2, step 4). In addition, a comment icon and a share icon, as well as home

During the experiment participants were asked to use the prototype of the system while reading articles in the magazine and provide the evaluation of their quality of experience. We also compare reading experience with and without the system usage. At the end of the experiment we interviewed participants to solicit their overall comments and suggestions for potential improvements.

icon were always provided. The comment icon, when touched, allowed the user to upload their own multimedia content (photos or video) or type in their comments as text. It also provided access to the comments submitted by other readers. The share icon allowed the user to post and share their comments on social media sites: Google+, Facebook or Twitter. The home icon would show all media available for the entire magazine.

We used a recent issue (Spring/Summer 2014) of the Research at RIT magazine as a printed publication and redesigned it for the experiment by choosing three four-page articles. We assembled relevant digital content for each page of the articles. This digital content varied across pages and included different combinations of video, audio, a 3D animation, and a supplemental web material for different pages. The digital content was placed on the School of Media Sciences server.

Two versions of the redesigned magazine were printed. In the first version of the magazine we provided icons that designated available digital content on the margins of the pages. We used two colors for the icons: orange color signified media items that could be accessed from a particular page, while gray color was used for the media items that were not available for that page, but could be found on other pages of the magazine. This was done to inform the user about all digital media associated with the entire issue. The version of the magazine with the printed icons was intended for the use with the smartphone. When the user scanned the page, only those touch icons would appear on the screen (video, audio, etc.), if there were corresponding media items available for viewing. The user needed to scan the page to see the controls, but could move the smartphone away from the page afterwards to explore and view media without the necessity to hold the phone over the page. The second printed version of the magazine did not contain any such icons and was used for the traditional reading. The printed icons had the same appearance as the user interface touch icons on the smartphone application. Figure 3 illustrates the pages of the redesigned magazine with the printed icons (Figure 3a) and a screen of the smartphone application depicting touch icons, or control buttons, on the interface (Figure 3b).

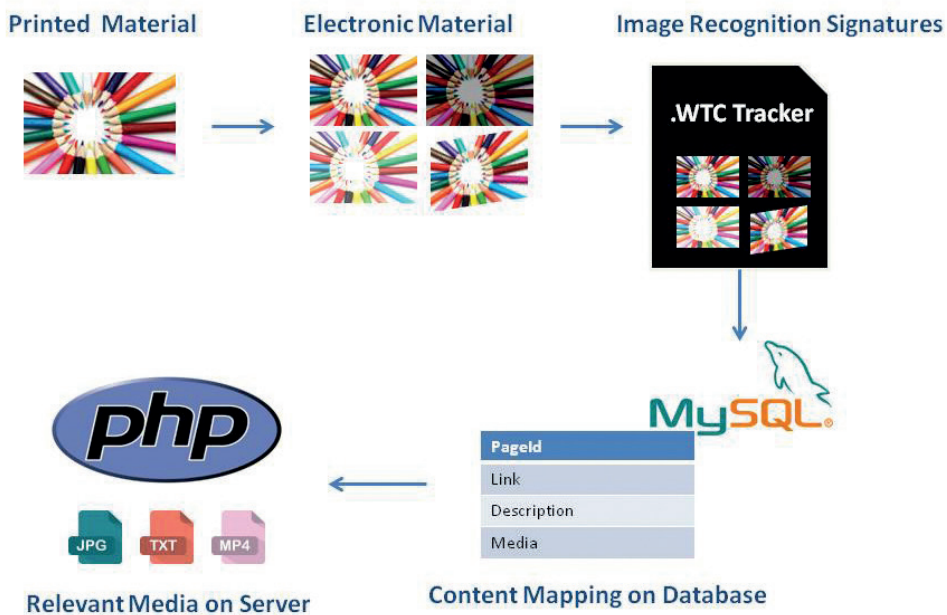


Figure 1: Operation of the RocReadaR system, where: 1) The publisher provides printed magazine or magazine pages alongside with digital media files or web links; 2) The necessary print material is converted to electronic format, such as PDF, PNG or JPG, and Multiple copies of the same print material with varying image characteristics such as brightness, contrast and skew angle are stored for better recognition to account for unknown environmental lighting conditions during recognition; 3) The Wikitude studio is used to create a tracker file of these images; this tracker file is stored on the web server and contains images' signatures of all our pre-defined content which is later used for recognition; 4) Each instance of print material is associated with multiple instances of relevant web media, these one-to-many mappings are stored in a MySQL database along with some metadata associated with the web media; 5) Upon image-recognition from print media, we can use the database mappings to fetch linked media stored on our server using PHP scripts

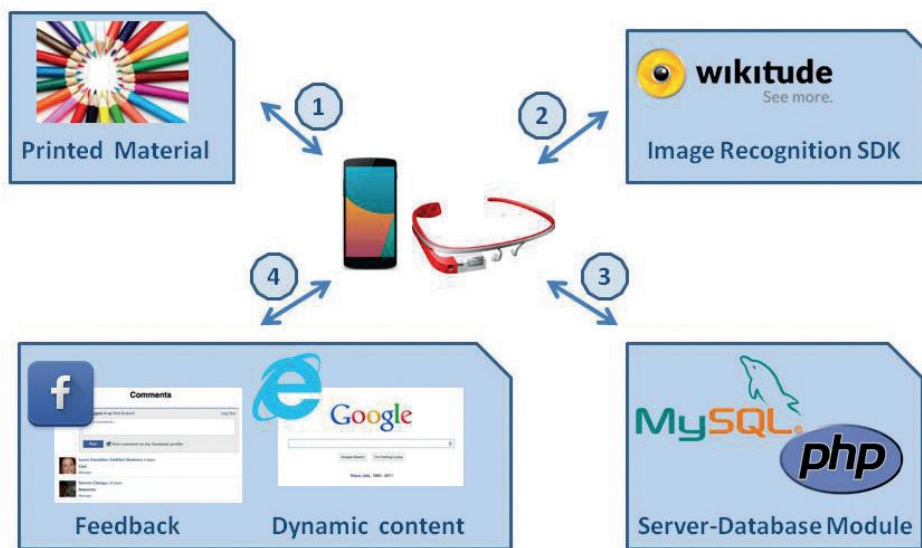


Figure 2: User interaction and image recognition with the RocReadaR app.: 1) The user runs our application on an Android smart device and points it at a printed document with the relevant media already linked with it, this media is stored on our server and is defined on our database; 2) The Wikitude SDK then helps to recognize if the print content is pre-defined or not, by using .WTC 'tracker' file that was generated when we stored the data, and by comparing the image signatures in the tracker, the SDK returns a match/miss result; 3) If a match occurs, we search for the mapping of print document to relevant media on the Server-Database Module and return this information to the Android device; 4) Using the response from the server database module and metadata of relevant media we present Web and Social media in an augmented environment on the Android device



Figure 3: The pages of the redesigned magazine: (a) An open page of the redesigned Research at RIT magazine with the printed icons on the margins designating digital content, where the icons for the available content are printed in orange color; (b) The Nexus 5 smartphone with the open smartphone application, where the touch buttons designate the available digital content matching the orange icons on the printed page, and clicking on the buttons provides easy access to the digital content

4.3 Experimental procedure

Participants were seated behind a desk with a magazine placed on the desk. After introducing the study with the orientation script, which contained information about the purpose of the study and the usage of smart devices, each participant was asked to fill out a consent form and a background information questionnaire. Afterwards, the participant was asked to read two different articles, each selected from a different version of the magazine, page by page, and after finishing reading each article in the magazine, answer a questionnaire. The combination of the two articles for each participant was randomized to minimize potential influence of the content. Participants were randomly assigned into two groups with different experimental reading conditions described below, ensuring an equal number of both genders in each group.

The first reading condition group read a selected article in the magazine without any device, in a standard way. Then they were asked to read a second article, this time using a smartphone (Google Nexus 5 smartphone) with our transmedia application, which was placed on the desk near the magazine. Participants were explained how to use the device prior to reading via a printed instruction sheet and then asked to explore the system. The availability of additional digital content affiliated with the article was designated by printed icons on the margins of the article.

In the second group, the sequence of reading conditions was switched. The participants were asked to use the transmedia application on the smartphone while reading the first article. Subsequently, they read a second article without any device. During the experiment

the selection of the articles and their order for every participant were randomized to minimize the influence of the content of the articles on the participants' responses. Both groups filled out a questionnaire after each reading, so that two questionnaires were filled by every participant.

The questionnaires consisted of 7-point Likert scales and were designed to evaluate the quality of experience and reading performance using self-reported measures. The questions focused on the reading performance contained scales to evaluate narrative understanding, attentional focus, narrative presence, interest and retention of information. We used Nurmi, Laine and Kuula (2014) approach when designing these questions. The questions directed to evaluate the quality of experience contained scales to rate both instrumental qualities, including usability, usefulness, and satisfaction, and non-instrumental qualities, such as aesthetic qualities, and motivational qualities (Geerts et al., 2010; Mahlke, Lemke and Thüring, 2007; Albert and Tullis, 2013). The reading performance questions were included in every questionnaire given after reading an article. The quality of experience questions were given in the questionnaire every time the participant read an article using the prototype. After reading the second article we also asked the user to explicitly compare quality of reading experience between the two reading conditions. All questions were presented along with the linear scale of 1–7, with the end points designated as “Not at all” for 1, and “Extremely” for 7. There were 39 rating scales in total.

When using the system, the experimenter suggested participants to try out different functions of the transmedia application, including sharing comments and

media content via social media, to gauge the participant opinion about the usefulness and desirability of these options. At the end of the experiment, after the

reading tasks and questionnaires were completed, participants were interviewed about their opinions, suggestions and insights.

5. Results

To analyze the data, the questionnaire responses were aggregated in groups pertaining to the following evaluation categories: 1) reading performance including comprehension, attention level, information interestingness, and presence; 2) usability (ease of reading); 3) usefulness or utility (effectiveness of reading); 4) satisfaction (level of enjoyment when reading); 5) motivational quality (interest level for reading); and 6) aesthetics of the design. We treated responses as interval scale data based on previous research (Traylor, 1983).

To present the results, firstly, we will describe evaluations of the reading performance in two conditions: paper-only and augmented paper conditions. Secondly, we will compare reading experience in these conditions with respect to usability, usefulness, satisfaction, motivational quality, and aesthetics. And, finally, we will summarize participants' comments and responses during the interviews.

5.1 Reading performance

Here are the examples of questions we used for the reading performance assessment: "I had a hard time following the thread of the story"; "My attention was focused on the article"; "I recalled or pictured myself in the events or space in the story". The rating scores for reading performance with and without the smartphone prototype are shown in Table 1.

Table 1: The mean values and standard deviations (in parentheses) for reading questions with and without the system usage

Question category	Mean values Reading with the system	Mean values Reading without the system
Reading: comprehension	4.2 (0.9)	4.1 (1.2)
Reading: attention	4.3 (0.9)	4.5 (0.8)
Reading: interest	5.2 (1.4)	4.9 (1.5)
Reading: presence	4.5 (1.4)	4.7 (1.2)

There were no significant differences between the articles in the two conditions for reading performance in terms of comprehension, the effort of focusing attention; and presence, when the ratings were compared using a paired t-test. The participants could remember and describe the content of the articles in both cases. However, in a number of instances in the prototype usage condition, when asked to recall a specific detail,

the participants recalled the content they learned from digital media that was not contained in the printed material. When answering the questions on comparing quality of reading experience (Table 1), the participants found the articles read with the additional digital content provided by the system prototype easier to remember and more interesting to read. Similarly, during interviews they mentioned the availability of digital content as a factor to learn and remember more material.

5.2 Usability

Table 2 summarizes the results for different user experience dimensions in two reading conditions: digitally augmented reading condition, when the smartphone app was used; and paper-only reading condition, without the app. In addition to the ratings, the users were also given an option to explain their answers by providing written comments. The mean values for the usability and other user experience dimensions for both conditions are shown in Table 2, along with the paired t-test results.

Table 2: The mean values and standard deviations (in parentheses) for user experience ratings when comparing two reading conditions

Question category	Mean value Reading with the system	Mean values Reading without the system	Paired t-test (two-tailed)
Usability	5.7 (1.6)	5.2 (1.8)	no difference
Usefulness	6.0 (1.4)	4.6 (1.8)	$t = 2.13$, $p < 0.05$
Satisfaction	5.7 (1.6)	4.3 (2.0)	$t = 2.12$, $p < 0.05$
Motivational quality	5.8 (1.1)	4.9 (1.5)	$t = 2.07$, $p < 0.05$
Aesthetics	6.4 (0.65)	4.6 (2.0)	$t = 3.66$, $p < 0.01$

Specifically, for the usability assessment we asked the participants to rate the ease of reading and the reading effectiveness for the two reading conditions (e.g., How easy was it to read the article in each instance?). The effectiveness was explained as to be adequate to accomplish a purpose, and/or produce the intended or expected result, according to the Dictionary.com. As it can be seen from Table 2, there was no statistically

significant difference in the usability measure based on the ease of reading and reading effectiveness. The users were divided in terms of their assessments: several participants gave higher values for the augmented reading condition (“it is more effective to read with digital inputs”; “helps the user to look for more information”), while others rated that reading from paper was more effective, were confused about how to properly scan the page, and reported that accessing digital media takes a long time. As one participant mentioned: “It is troublesome to scan every page. And it is a lot information to understand”.

5.3 Usefulness

The usefulness was evaluated via the ratings on remembering the content of the articles. The difference in responses was above the significance level in favor of the article read using the smartphone app ($p < 0.05$). When commenting on their ratings, several participants explicitly mentioned that they remembered more about the article because of the additional content they observed on video clips. As one participant has written as a comment: “Again, pictures, audio and video will make the article easy to remember and understand. Therefore, I vote for the article presented to me with interactive media!” On the other hand, a few participants found a print article easier to remember because of their personal interests and specific content. One participant singled out the app as being a negative factor: “Content from the second article (print only) I can recall well because of interest and, probably, less distraction as there was no smartphone interaction”.

5.4 Satisfaction

To evaluate the users’ overall satisfaction, we asked them to rate how enjoyable their reading experience was in both conditions. Similar to usefulness, motivational quality and aesthetics, satisfaction was also higher for the augmented reading ($p < 0.05$). As with the other scales, not all participants agreed on the higher satisfaction assessment, which is reflected in the values of standard deviations. Five users preferred the paper-only conditions. One of them stated that print magazine is sufficient by itself to provide news information. The other four were not satisfied with the way the current prototype worked. As an example, below is the quote from the note written by one of the users for the satisfaction question: “I preferred reading the magazine without the use of the app. With the app, because it needs to scan the entire page, I needed to stand up, which was annoying after the second time. If it could scan a smaller area of the article in order to gain access to the media, that would be more comfortable for the user, as it would allow them to stay in a comfortable position (laying down, sitting, etc.) and would not

break their train of thought. Also, the media provided either too much information or was redundant; that, in itself, was annoying, too.”

5.5 Motivational quality

Motivational quality in the context of the user experience evaluation can be understood as a characteristic of a system (or a function) that compels and motivates the user to utilize this system (Mahlke, Lemke and Thüring, 2007) or perform the function, and is associated with the level of engagement. To assess motivational quality, the participants were asked to compare reading the articles in two conditions in terms of the interest level (e.g., “Comparing two instances of reading, how interesting it was to read the article?”). As it can be seen from Table 2, the users rated reading the article in the “smartphone” condition, slightly but significantly more interesting, compared to the paper-only condition ($p < 0.05$). One of the participants commented: “With an augmented reality app as an extra reading tool, it’s more interesting, for sure”. When reading the paper-only article was deemed as more engaging and interesting, the content and its relevance to the user played a major role: “The second one (print-only) was much more interesting, since I recently participated in a table booth, I felt more related to the second one”.

5.6 Aesthetics

The answers to the aesthetics related question (“Comparing the two articles, how appealing do you find the visual design of the content?”) showed a clear statistically significant preference for the article in augmented reading condition ($p < 0.01$). As stated by one participant: “The article ... had more appealing design because of interactive visual content”.

5.7 Interviews

The interview questions were designed to solicit users’ input on observed shortcomings and attractive features, how to improve the system in terms of its usability and usefulness, what functions they would like to see, their expectations for the quality of content, and the likelihood of using the app for reading news media in the future.

Overall the users expressed many positive comments and favorable opinions about the system, and were particularly impressed by the availability of interactive digital and social media at their fingerprints while reading magazine articles: “In its current prototype, I really like the interactive media provided by RocReadaR!”; “The idea as it is, is great! The system could refer the reader not just to predefined sources on the server but also to links or other content depending

on keywords in the article. In that way it could be used for any magazine.”; “It is really cool how there is the social aspect to it, and also the content aspect!”

For a few participants, if their response was less enthusiastic or neutral, it was often in relationship to the particular choice of the magazine, the selection of particular digital media, or an Android platform. They commented: “If it’s an app for an Apple device, and if I read more RIT magazines, yes. I would use it. I think it’s very cool, but personally I read novels over magazines, while this app is for magazines”. However, there were more skeptical views, as well: “I think the news article is self-contained, and enough for a general reader. The digital media part is kind of unnecessary”. And even: “I don’t like it. You can use digital magazines instead”.

The main concerns and suggestions for improving the usability of the system were associated with the speed of the application, its performance stability, configuration and the display quality of additional media items, particularly the video quality. The users wanted to have more feedback to know what the system is doing, e.g., if the page scanning is completed or the video clip is going to last more than a minute. They also suggested to use short, 1–2 minutes’ video clips, and to provide an option for redirecting the user to a website if longer videos were available. If the access to the media items was not instantaneous, the users commented about losing track of reading.

The necessity to scan the entire page by holding the phone at a considerable distance was recognized as annoying. To correct for that, scanning only parts of the pages was proposed. Moreover, actions required to operate the current system could turn some people off. As the user put it: “The current state of the app is not very useful. As an individual, I would not like to select a page, put it in focus and then see the additional information.” Although the users liked the printed icons on the magazine margins and their automatic appearance on the smartphone as control buttons, they repeatedly pointed out that a closer link with the media is desirable. For example, if there were a video complement-

ing a specific sentence or a paragraph in the text, then underscoring a relevant word, or marking a sentence with a symbol would aid in explaining or illustrating the text.

Among additional features the participants wanted to have was a search capability for finding more information about the topic. “More content using Google API and integrating search result using data mining techniques to get relevant information around the topic would be good.” “What is being described in the article should be searchable through the app.” On the other hand, some users felt that the augmentation with sufficient digital content eliminates the need to do a search: “It would be great if links are provided to the information on the people presented in the article, so that one does not have to do a Google or Wiki search”. There was a recommendation to implement a “save” option for the later use: “I think the app could improve the user experiences, if everyone were able to log in and access their previous research and accessed content”.

Commenting on creating and sharing content, the users wanted to be able to capture images, videos, or other media, provide textual comments and annotations and to share media and web links with friends via the app, social media, blogs and also, email.

There were suggestions to look at the accessibility issues. “I did not get quite the idea how it would be helpful for people with hearing impairments. Or maybe I had a wrong expectation.” “The speed of showing the related information should be controlled for people having different abilities of taking in information.” – are some of the comments we recorded.

Finally, there were numerous comments on the necessity to communicate relevant, compelling and high quality content that is not redundant. For many participants providing new information, not already explained in the article, especially video clips and interactive 3D content, is a critical factor for possible future use. As it was phrased succinctly: “I already know the content [of the article] and got tired of it. So it doesn’t attract me”.

6. Discussion

The RocReadaR system of transmedia news publishing system builds upon previously published concepts that integrate different media and devices including digital information, data on a web server, physical objects, and paper and printed publications for storytelling and communication (Norrie and Signer, 2005; Vogelsang and Signer, 2005; Norrie et al., 2007; Fedorovskaya and Yu, 2014). The aim is similar – to utilize the many unique affordances of paper as a traditional publishing medium (Sellen and Harper, 2003)

and combine it with digital data to enable embodied interaction and enriched user experience and, at the same time, incorporate evolving digital media channels with an easy access to the digital realm. Unlike several previously developed systems, however, which were created on the basis of special paper and an electronic pen as an enabling technology and focused on active writing to produce additional content, the RocReadaR uses Augmented Reality and is a smartphone application. This approach, we hope, can prove successful for

engaging a broader public with news media and collaborative transmedia storytelling, and inform future developments in publishing communication.

The results of the present study seem to indicate that. As evidenced in the participants' ratings and their comments, our transmedia publishing system, even in its current limited implementation, provided a compelling user experience. The users gave superior evaluations for many user experience dimensions we tested when reading the research news magazine using our system compared to the paper-only condition. Many users rated highly the perceived usefulness of the application and mentioned that they were able to learn more information in supplement to the printed content. Here is an example of the comments we have recorded: "Fun! Adds a whole other dimension to reading. Helps reader to remember and connect text to digital world in an innovative and helpful way ... would love to see with text books."

The significant result that we obtained concerns motivational quality of this method of publishing, which can be particularly important for engaging young people with news media.

The way the printed magazine and the prototype conveyed the availability of digital content played a large role in this regard. Many participants acknowledged that providing easy to recognize, familiar icons on the articles' margins of the printed magazine motivated them to use the system and explore content further.

7. Conclusions

The study results led us to conclude that the transmedia reading system is perceived to be a useful tool for providing more engaging reading experience, additional in-depth information to support learning, social sharing, and a cool factor that can help motivate news reading and reading, in general. The majority of our participants felt that they would use the system and recommend it to their friends if it is improved. They also acknowledged that this method of reading can change their perception of printed publications as obsolete and limited by providing interactivity and an access to distributed media.

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They commended the system's interaction design – that the icons signifying available digital media items on each printed page were appearing on the screen as control touch buttons after scanning the page to view the media.

The sharing feature was deemed very desirable for sharing interesting reads, and to engage friends by sending links, photos, notes or captured pages.

Among recommendations for future improvements and releases, the participants suggested to implement an instant "read" feature, so users can share views and content, if they happen to read the same material in synchronicity. They also asked for the "save" feature to bookmark digital material for later viewing, and repeatedly mentioned search function as necessary for the successful application.

Still, several users were rather neutral about the usefulness of the application for reading, particularly in its current form. When asked a question about which method of reading is more useful and preferred, 15 out of 24 participants chose interactive reading method because of more information and more enjoyment it provides, 4 participants reported no difference, while 5 participants chose traditional reading with no app, noting that the application distracts from focusing on the article. One user felt that the digital media part was unnecessary for news reading. She thought, however, that the application could be useful for other types of reading material such as text books.

The results of the experiments will be used to formulate design recommendations for implementing transmedia publishing system in practical real-life applications and to improve our prototype.

In the future we plan to improve the system based on the users' responses and run a large RIT campus-wide trial to obtain real-life usage data to investigate whether the benefits of the system can translate beyond the lab into the real world. The second goal is to fully implement and test the transmedia reading method using wearable devices.

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