

EtiquetAR: a Tool for Designing Tag-based Mobile Augmented Reality Experiences

M. Pérez-Sanagustín, A. Martínez, and C. Delgado Kloos

Abstract—This paper presents *etiquetAR*, a web-mobile-based tool for supporting the design and enactment of mobile augmented learning experiences based on tags. *etiquetAR* is based on the idea that digital tags (such as QR codes and NFC), when attached to a particular object or location, add a digital layer of information that extends and transforms physical spaces into digitally augmented spaces. We present two illustrative scenarios that use *etiquetAR* in combination with smart mobile devices to augment a physical space for supporting a tag-based mobile augmented learning experience. These scenarios are two examples to inspire future work towards the design and enactment of novel mobile learning activities based on tags.

Index Terms—Mobile Learning, Tags, Augmented Spaces, QR Codes

I. INTRODUCTION

THE advent of mobile smart devices in combination with electronic and software advances has transformed the way we interact with our physical surroundings. Novel applications propose new forms of interactions that superimpose layers of “digital” information over physical spaces transforming them into *augmented physical spaces*. Learners can interact with these augmented physical spaces using their mobile smart device for connecting anytime and anywhere to remote places, resources and people. These augmented spaces extend the boundaries of the learning experiences offering new opportunities for education.

There are many researchers exploring how to benefit from the *anywhere* and *anytime* capabilities of mobile smart devices in combination with other technologies for creating digitally augmented spaces with learning purposes [1, 2]. However, in this paper, we focus only on those approaches that use tagging technologies such as QR codes and RFID/NFC tags as the means for augmenting reality. For us, these tags facilitate the access to layers of contextualized information over an object or a place.

Recently, several studies have started to explore the

learning benefits of using tagging technologies such as RFID/NFC or QR codes in educational contexts for augmenting the space. For example, in a paper by Ramsden (2008) [3] the author proposes different situations in which using QR codes can augment the students’ learning experience: for a students subscribing to RSS news feeds, to augment printed learning materials, to integrate an alternate reality game or to provide *just in time* information in a face to face lecture. Liu et al. (2007) [4] use QR codes to superimpose a 3D animated virtual learning partner (VLP) to particular zones for improving students’ English level. Another study by Ghiani et al (2009) [5] presents a location-aware museum guide for supporting museum visits based on RFID tags. Other studies show how QR codes can be used as scaffolding in a paper-plus-smart phone learning context [6], or as the means to reduce the distance between the students and the learning materials [7].

However, and despite of the increasing number of initiatives in this line, the adoption of these tag-based experiences is still very low in education. One of the reasons is the lack of tools specifically created for supporting these types of experiences. Currently, there are several tools for generating QR codes and for configuring NFC tags, but none of these tools has been designed with learning purposes. This means difficulties for both practitioners and students to create novel learning experiences using tags. We need simple and easy-to-use tools for facilitating practitioners and learners the design and enactment of their tag-based experiences.

I. ETIQUETAR: TAGGING YOUR LEARNING EXPERIENCES

This section presents the first prototype of *etiquetAR*. In this prototype the tags are QR codes, but we plan to extend the application for supporting other types of tags such as NFCs. *etiquetAR* is composed by two applications: (1) a web-based application for supporting creating, personalizing and managing tags and (2) a mobile-based application for accessing the information hidden in the tags. You can sign up for the first prototype of the tool here: <http://www.etiquetar.com.es>.

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Fig. 1. *etiquetar* Web-based page. This page can be access at: <http://www.etiquetar.com.es>.

A. etiquetAR Web -based application

Both practitioners and students can create, personalize and print their interactive tags (QR Codes) into three simple steps: (1) create a tag, (2) link the resources to a profile and (2) print.

(1) Creating a tag: Once signed up the user is redirected to a home page. This page shows the list of tags created by the user and the buttons to create, delete or update a tag (Fig. 2).

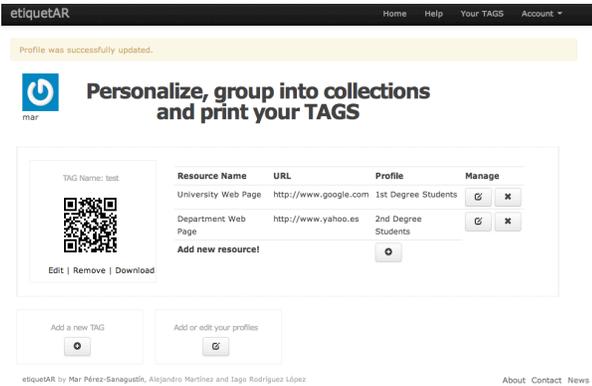


Fig. 2. User's home page. This page shows the list of the users' tags. In this page the user can create, update or delete tags.

When clicking on the button "Add a new TAG" the user is redirected to the page *Create a new TAG* (Fig. 3). In this page, the user has to fill in the information about the new tag: (1) the name of the tag, (2) the name of the resource that s/he wants to show in this tag and (3) the URL linking to this resource (text, images, videos...). One tag can be associated to more than one resource. The user can add as many resources as s/he likes using the button "Add new Resource". Once created, the tags can be updated or deleted.

Fig. 3. Create a New TAG. The user can create as many tags as s/he likes and each tag can contain more than one resource.

(2) Linking resources to a profile: Each of the resources of a tag can be associated to a particular profile. The profiles will be used to personalize the information attached to the tag. By default the resources are not associated to any profile, but the user can create their profiles clicking on the button "Add or edit your profile" (Fig. 4), i. e. "Profile for 1st degree Students" and "Profile for 2nd degree students". Once the profiles are created, the user can get back to the home page and update a tag relating its resources to a particular profile.

Fig. 4. **Edit profiles.** The user can create profiles and relate them to the different resources for personalizing the information access to a tag.

(3) Print the tags: Once the tags are created and personalized, the user can download them as a .png image and print them. The printed tags can be attached to any object to or location.

B. etiquetAR Mobile-based application

One of the advantages of etiquetAR is that it does not require any specific application to read the tags. Since the tags are generated using the QR standard [8] any QR Reader can be used to access the tags information. Therefore, if the users have already a QR Reader installed in their smart devices (Android devices have a native application installed by default) users can interact with the tags and access to its associated resources. If the user does not have any QR Reader installed, s/he can download any from the current applications available¹.

When reading the tag, two situations are possible. First, if the tag accessed contains one or more resources but they are not associated to any profile, the user would be redirected to the first resource associated to the tag during its creation process. Second, in case that the tag accessed contains resources associated to a profile, the user would be redirected to a "Profile selector" page where s/he will be asked to select one of the available profiles (Fig. 5). Afterwards, the user will be shown only the content associated to that profile.



Fig. 5. **Profile selector.** The user can create profiles and relate them to the different resources for personalizing the information access to a tag.

II. TWO ILLUSTRATIVE SCENARIOS USING ETIQUETAR

This section presents two scenarios "Discovering the Campus (2012)" and "Discover the kidnapped scientist". Each scenario describes a tag-based learning experience taking place at two different augmented spaces. In both scenarios etiquetAR is used for generating the tags to augment these spaces: an *outdoor* space in the first scenario and an *indoor* space in the second one.

A. Augmenting outdoor physical spaces

"Discovering the campus 2012" is the third edition of a learning experience that takes place every year since 2010 at the University Pompeu Fabra with first-year students of engineering degrees [9]. The main objective of the experience

¹ QR Readers List: <http://www.mobile-barcodes.com/qr-code-software/>

is facilitating students a first contact with the university campus, its services, community, at the same time that they meet other freshmen.

For the experience teachers prepare tags containing information about the different campus services. These tags are distributed in key physical points of the campus buildings. Students use *smart mobile devices* to interact with the tags and access to videos, pictures, sounds that augment the information about the physical spaces of the campus.

In the 2010 and 2011 editions, teachers used NFC tags to digitally augment the campus. However, using NFC has some limitations. On the one hand, a special application based on a J2ME developed is required for recording the contents in the tag. This application is difficult to use: the user has to be physically touching the tag to record any content and, once recorded, the tags cannot be rewritten until the experience is finished. On the other hand, students cannot use their own smartphone because, currently, there are not many devices that include a NFC reader. Also, all students access to the same content, since the NFC tags are not prepared to contain different contents depending on the students' profile.

To solve these limitations, in this last edition of the experience (2012) teachers used *etiquetAR* to generate the tags. Two different teachers were involved in the tag generation process. Every teacher was in charge of generating content of a different area of the campus. Since the tag does not change depending on its content, teachers could change the content anytime once the tag was generated (before, during and after the experience). Also, teachers used the profile functionality for adding different contents depending on the students' degree: Telematics, Sound and Image or Computer Science. In this way, when interacting with a tag, students could access the content related with their particular degree. Moreover, students could use their own smart mobile devices for interacting with the tags.

In this learning scenario, *etiquetAR* is used for **augmenting a physical outdoor** space and for **personalizing the students' experience** by showing content related with their studies. This experience was enacted on September 2012 and the data is currently under analysis.

B. Augmenting indoor physical spaces

"Discovering the kidnapped scientist" is a tag-based museum experience for primary school students. The experience has been designed for the CosmoCaixa science Museum of Alcobendas (Madrid, Spain). The objective of the experience is to make students reflect and put into practice the science concepts that they learn in class involving them in the generation of the museum contents. The experience is structured into three different phases: *before*, *during* and *after* the visit to the museum.

Before the visit, the students work in groups for reproducing and record some of the experiments that they will find in the museum. The multimedia resources generated in this phase will be the contents of the digital tags that will be used for augmenting the exhibits of the museum. *During the visit* the students have a mission: they have to discover who has been the kidnapped scientist. Each team is provided with a tablet with an application that will guide them through the different

exhibits of the museum. In each exhibit, students have to interact with a tag that contains some of the multimedia resources they have generated in the previous phase. Each team will visualize the content generated by another team and answer a question related to the exhibit. Students will have to report the visit taking pictures and writing comments using their tablets. *After the visit*, the students are provided with personalized artifacts such as comic stories using the material collected during the visit. The teacher will use these artifacts in class to make the students reflect about the whole experience.

In this scenario, **both the students and the teacher will use *etiquetAR* for generating the tags to augment an indoor space**, the museum. The contents associated to the tags are resources generated by the students. The profile functionality is used in this case to **provide a different experience for each team**: each team will access to a different content. This experience will be deployed in November during the Madrid Science week.

III. CONCLUSIONS AND FUTURE WORK

This paper has presented *etiquetAR*, a mobile and web-based application for supporting the design and enactment of mobile augmented learning experiences based on tags. To show how *etiquetAR* can be used in different contexts for augmenting physical spaces with several learning purposes we have presented two different scenarios. In the first scenario, "Discovering the campus 2012", *etiquetAR* is used for augmenting an *outdoor* space to support first-year university students in an exploratory learning experience for discovering the University campus, activities and services. In the second scenario, "Discovering the Kidnapped scientist", *etiquetAR* is used for augmenting a museum *indoor* space to support primary school students in a reflective science learning experience around a museum exhibition.

From these two scenarios we can highlight the main characteristics that make *etiquetAR* a good application for educational contexts:

- 1) ***etiquetAR* is easy to use.** Any user can generate their personal tags into three simple steps. This simplicity makes that both practitioners and learners can participate in the design of the tag-based experience.
- 2) ***etiquetAR* enables personalizing the user experience.** Each tag created with *etiquetAR* can be associated to more than one unique multimedia resource. At the same time contents can be associated to particular profiles. *etiquetAR* facilitates creating tag-based profiles personalized to different users.
- 3) ***etiquetAR* does not require any special mobile application.** Any QR tag reader can read the tags generated with *etiquetAR*. This facilitates the enactment of learning experiences designed with *etiquetAR* since users can use their smart mobile devices for participating in the tag-based experience.

As a future work, we plan to continue extending the application with new functionalities: (1) for supporting the design of tag-based experiences based on other types of tags

such as RFID/NFC and (2) for enabling users to share their tags. We are also working on new scenarios in which etiquetAR is going to be used to support a collaborative process involving students from different countries to augment the urban space of three European cities. We believe that both the first prototype of etiquetAR and the scenarios presented are a good starting point for exploring the potentiality of digital tags for transforming any space into a learning augmented space.

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