Implementation and Usage Scenarios of a Participatory Platform for Cultural Environments

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Abstract. Raising audience awareness over the creation and evolution of a cultural participatory digital platform is a critical point for its acceptance. The proposed platform adopts user involvement in the content collection level through the implementation of a mobile application easily downloadable to the user's smartphone and the use of a web portal application. Complementary web portal permits the management of the collected content in a trustworthy manner adopting an extended role-based access control model for authorization purposes. Users can formulate private groups to contribute and share content. Platform guarantees the soundness of contributed content through an auditing procedure requested by the contributors and conducted by experts selected randomly. In order to stress the applicability of our platform to various cultural environments, we present a number of usage scenarios targeting various stakeholders from specialists and museum curators to students, teachers and simple enthusiasts aiming in the development of coherent narrations.

Keywords: Participatory platform · Cultural content · Web portal · Mobile application

1 Introduction

Cultural heritage is useful as a means to highlight common origins and achievements among nations around the world. Cultural heritage management tries to reveal and present our common origins and cultural achievements, more than any other way [16]. Through cultural heritage management, international structures like the European Union try to reach the target of Europeanization, the inculcation of the European Idea among the nations of Europe [6]. The explosion of Internet use around the world provides the essential background to amateurs and enthusiasts of culture to search for cultural content or collect and publish their own content [1–3]. This trend poses a series of questions regarding the quality and the usefulness of such content, in the case it is contributed by non-experts. Is the contributed content sound or can it be beneficial to specific communities? Answering these questions is not a simple task. As the volume of digital cultural content rises and the technological resources are evolving in terms of efficiency and availability, the need for cultural data management becomes a priority. New mechanisms and systems need to be proposed and implemented to manage the produced, vast

amounts of cultural data. Participatory platforms are such systems where data are being contributed by users in smaller or larger amounts, collected, organized and presented to the public. Users can range from established scholars and university professors, to simple enthusiasts of cultural heritage or professionals in the cultural market.

In recent years, several participatory systems are trying to open new ways in cultural heritage digital management [1–3]. Also there are others that exploit the notion of open participation, complementary [6]. The first experience from those systems indicates that not only a participatory system needs to be interactive, dynamic and easy to use, but also to constantly urge users in involving more and more with the platform and integrate new services based on participant feedback. Here we propose a participatory system design oriented to user needs, experts or not, concerning content contribution and authoring. We involve modern mobile devices in the digitization and content collection procedures, along with content visualization functionalities through cultural maps. Our main goal is two-fold: the provision of a learning tool for culture, and a dissemination tool for expert and public communities to communicate cultural content they create or collect in a trustworthy manner.

The proposed system design guided the implementation of Culture Gate, a participatory platform that aspires to become a fundamental digital platform that will receive cultural heritage content from different sources (scientists, artists, the public etc.), preserve and digitize it, organize it in widely accepted ways and present it to the online users in a friendly, modern and innovating manner. By making scientific information public, we allow users to correct, update or enrich cultural content leading in more qualitative data. Our implementation is oriented to satisfy typical usage scenarios concerning cultural content searching, viewing, uploading and authoring, that may be applicable to various groups of users like experts, artists, educators, tour operators, public authorities or simple enthusiasts. Culture Gate takes special care to protect sensitive data (like user credentials and contributed material) through a suitable authorization mechanism based on the extension of role-based access control model (RBAC model [17]).

The platform offers a dedicated smartphone application which the users can use to collect cultural content and store it to the system. This capability offers users the opportunity to capture tangible or intangible cultural content in real-time and share their findings with the community in an open or private manner. Field scientists are extremely benefited by such a service since they could digitize their findings, immediately and store them in a secure environment for further management.

2   Related Work

Participatory digital platforms implement the participatory action research theory in the digital domain [8]. Oomen and Aroyo in [18] propose specific classifications of cultural heritage crowdsourcing platforms: correction and transcription platforms and projects [7], contextualization [9], complementing collections [10], classification [11] and co-curation [12]. There are platforms that support content contribution as a key functionality [1–3], while others support only complementary and occasionally the creation of crowdsourcing exhibitions where any user can be a contributor [6]. Moreover, some platforms

host information about tangible cultural content [1, 3] while others deal with intangible content [2] or both [6] and platforms that support mobile applications to view and search content [3, 6], like Muse [3] which hosts native iPad apps for digital libraries with cultural heritage content. Current trends in cultural heritage management platforms dictate the integration of mobile services within participatory platforms [1, 3, 9]. MQUADRO offers a dedicated tablet application [1], Muse hosts native iPad apps for digital libraries with cultural heritage content [3], while an application for android and iPhone is being used in a portal dedicated to storytelling in Denmark [9].

Security is a critical point concerning the public acceptance of a cultural heritage management and dissemination system [4]. An important aspect of security in cultural heritage platforms is the limitation of the user access to sensitive content. An RBAC based authorization mechanism for secure mobile services used in archaeological excavations is presented in [19], while an authorization model for musical heritage archives is described in [20]. A guiding services platform presented in [21] supports trustworthy content dissemination through an extended RBAC model.

Participatory platforms are gaining ground to market sectors like tourism or social sectors like education and sociology. TripAdvisor [13] is a successful participatory platform where users contribute content about sites, locations or businesses that interest tourists and visitors of a place. The amount of information contributed by users is so vast and rich that no dedicated project team would ever accomplish the task of collecting these data. Second Life [14] is a participatory platform that simulates an alternative 3D world where everyone you see is a real person and all content is produced by users. Users interact with each other, solve problems and build a collaborative environment, of mutual learning, achieving the creation a functional society, without supervision of certified professors or teachers [15].

3   System Architecture and Implementation Technologies

Culture Gate is a general purpose platform that implements various services in order to support multiple objectives. Platform design addresses several quality issues like scalability, security, concurrency, integration of third party software, low resource cost and adaptability to several computational systems (mobile devices or traditional computers), in a participatory environment.

- Participation: The design should support multiple user roles with different permission levels that implement a wide range of activities, like content contribution or system monitoring.
- Scalability: The system needs to be able to support new functionalities and procedures in order to offer new services or enrich the existing ones, periodically. A static system is threatened to become out of date very quickly.
- Security: The users that contribute content must be sure that their intellectual property is protected and editable only by themselves. Also the system must protect the daily use, from malicious attacks (bots or hackers).
- Concurrency: As a participatory platform, the design should support multiple users simultaneously.

- Third Party Software Integration: Since the platform wishes to host artwork from artists or experts, the design must be able to support efficiently various software implementations with different technologies.
- Low Cost: The design must use limited resources in equipment, software and human dynamic to become viable and extend its lifecycle.
- Adaptability: The platform should be accessible both from traditional computational systems (desktops, laptop) and mobile devices (smartphones, tablets).

In order to support all the above design goals, the platform uses a modular architecture consisting of several modules (Fig. 1):
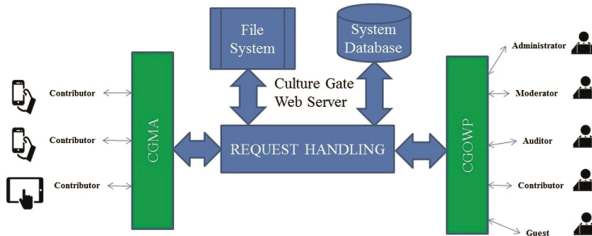

Fig. 1. Culture Gate system architecture

Culture Gate Mobile Application (CGMA). Smartphone application that collects cultural content from indoor or outdoor locations, in real-time and stores it in platform database and file system. CGMA feeds the system with cultural data.

Culture Gate Online Web Portal (CGOWP). Web interface where users can submit content or search and view cultural information. CGOWP presents the cultural content to the broad public.

Web Server. Supports the necessary tools for multiple operations like request handling from CGMA and CGOWP, hosting and managing system database and file system.

Request Handler. Implements scripts that get data from CGMA and CGOWP content contributors perform insert/update/search/delete operations to system database, create responses to send encoded data to CGMA users and displays user requested content.

File System. All files are stored in the platform file system. The files vary from php, html, xml scripts and apache files to directories with audiovisual material from users' contributions (CGMA and CGOWP). This system is isolated from all the other modules, except the handler, which is the only module that has permission to interact with the file system, for security reasons.

System Database. Stores all information concerning application data (including user credentials) and cultural data, contributed by the users.

The system follows RBAC model in order to classify users to several roles/groups (administrator, moderator, auditor, contributor, guest). Each user can have more than

one role. Furthermore, platform users can be registered users (moderator, auditor, contributor), simple users (guest) or members of the project team (administrator, moderator). In Table 1, we present user roles, types and their permitted operations.

Table 1. User groups/roles.

Role	Type	Operations
Administrator	Project team	Supervises every technical procedure, checks system integrity, assigns moderator roles to users, administers system database and file system, views all content (published and unpublished), deletes users
Moderator	Project team – registered user	Assigns user roles, creates user private groups, views all content, checks for offensive content and warns or bans users for this purpose
Auditor	Registered user	Views private content after assignment, informs contributors for the required content modifications
Contributor	Registered user	Views public content and private content of his group, uploads content. A contributor can modify only the content he contributes
Guest	Unregistered user	A nomadic user who views and searches public content

Platform supports different types of content (text, audio, images, video and multimedia). Text content can be content description, notes, event announcements, historical background information, theatrical plays and scripts, literary works or reviews and references. Images can be site and artifact pictures or depictions (like drawings, pictures, notes, sketch). Video can be animation or live activities like excavation or a folk dance. Audio content can be narrations, storytelling, interviews and vocal guides. Multimedia files can be a full demo package with all kinds of data types.

The basic entity of contributed content is the cultural item which is characterized by three categories of attributes: content-based, context-based and model-based attributes. Content-based attributes include thematic ones like title and description, and disciplines where the contribution belongs to. Context-based attributes include featured image (contribution's most representative image), files (multimedia files corresponding to the contribution), location (region's geographical coordinates where the contribution was uploaded), digitization equipment (equipment used to collect the data) and date (date and time of the contribution). Model-based attributes include the permitted operations on the specific item by specific user roles (like authoring or content visibility).

Culture Gate platform uses several technologies to implement all its modules: Apache Web Server, PHP scripts, MySQL database, Google Maps API and Android operating system (JAVA, JSON, XML). For the implementation of CGOWP we used a Windows 10, intel core i7-2600, 8 GB RAM at 1866 MHz system. For CGMA implementation we used Android Studio as the IDE, target SDK version 23 and minimum SDK version 8 and Samsung Galaxy Grand Neo to test the resulted application (Fig. 2).

Fig. 2. Cultural listings table schema (MySQL workbench)

4   Platform Services

Platform services are classified in three categories according to the sub-system they refer to: core, mobile and web portal services.

Core Services. *Security:* We propose an extended RBAC model (implemented by Request Handler) for authorization purposes. Platform supports five user roles with different authorization privileges to platform's content (administrator, moderator, auditor, contributor and guest). User passwords are encrypted (PKI) and disclosed only to the user. Several programming techniques are applied to encounter security breaches. Coding techniques used for security reasons are: input validation, compiler warnings heeding, simple security design, default denying, sanitizing data sent to other systems and effective assurance techniques. *Registration:* Creation of a new user account. Users complete fields like username, email, password and discipline. *Moderation:* The platform allows registered users with elevated permissions to monitor the daily procedures and keep the platform live (like monitoring disciplines, CGMA monitoring, cultural information uploading and management). *Authoring:* Guarantees that platform content is sound and up-to-date. After assignment to a specific contribution by the moderator, the auditor checks the validity of the contributed content and informs the contributor for the needed changes. *Group formation:* When a registered user wants to formulate a private group to share content, in a protected manner, with other users, he communicates with a moderator. This user must provide a clear group description (like a class of students that implements an educational virtual tour to a museum) and a list of platform users who will serve as group members. This user will be the group leader and will be responsible for the content each member of the group uploads. This content will be private and restricted only to the group members for viewing. A group member that uploads private content must declare that this content is only available for the group members. A group of colleagues could create a private user group to share real-time content with each other. *Personalization:* The platform displays to a user, information according to his interests. User chooses fields of interest during registration procedure.

Mobile Services. CGMA's main task is to collect and upload digitized cultural content. CGMA offers three different services that can be used by several user groups to store real-time data. *Field service:* Capturing audiovisual content from an outdoor uncharted location (like an excavation point) and sending it with its coordinates and notes to the web server. Users complete fields like: Title, Description, Discipline, Audio/Video/ Image Files. CGMA sends geographical data automatically during the uploading procedure. *Street service:* Capturing audiovisual content from an outdoor charted location (like a city street) and sending it with its coordinates and notes to the web server. *Indoor service:* Sending text content related to a tangible cultural item (like an artifact in a museum), along with notes or audiovisual files to the web server.

Web Portal Services. CGOWP supports management, presentation and dissemination services. *Content organization:* When a user uploads content from data submission screens, he makes a series of choices that give semantics to each new record (like discipline). User has the ability to view related content to a specific point in cultural map. *Content viewing:* A user has two choices in order to view content: geographical map or list. *Content searching:* A user has several choices in order to search content: keywords, disciplines and geo-location data or their combinations. Dissemination and User attraction: calendar of events, news, serious games implementation, 3D representations, smartphone applications and time-lapse videos.

5   Usage Scenarios

Culture Gate is a collector, organizer and presenter of cultural heritage content. In order to highlight the platform capabilities, we present specific scenarios based on the used service carrier: web portal or mobile device.

Web Portal Based Scenarios

Guest Searching and Viewing. User accesses a cultural map where he views all content as pins on a geographical map and lists of cultural information, organized per discipline. The map displays every public listing, contributed by registered users, as a pin. Pins are grouped by discipline and can be filtered by keywords or disciplines (one or more). Every discipline has a different color and icon for its pin. Figure 3 displays the cultural map with all information and Fig. 4 shows a filtered version of the map with the keyword "Acropolis" and the discipline "Museology". When the user clicks on a pin, an information box is displayed with some information. If the user clicks on the information he will be transferred to listing's dedicated webpage where he can find all the needed information (Fig. 5).
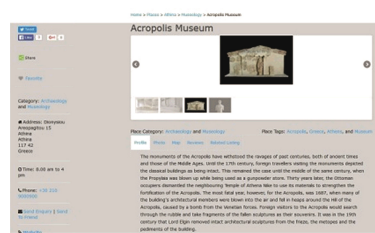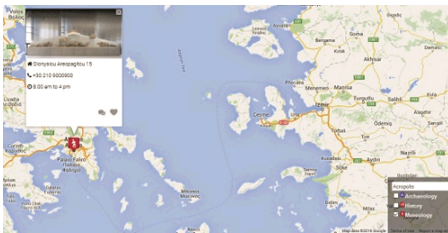
Fig. 3. Unfiltered view of cultural map

Fig. 4. Filtered view of map with keyword "Acropolis" and discipline "Museology"

Fig. 5. "Acropolis Museum" listing page

Registration. Every user can register to Culture Gate by accessing the "User Registration" screen. The user submits credentials (username, password) and information about the discipline he serves mandatory. Optionally, user declares specialty and fields of interest. This procedure is vital for system, to personalize the presented content according to user interests and draw information to formulate the auditor pool.

Authoring. When a registered user makes a content contribution and marks it as "Needs Authoring" then the system initializes the authoring procedure, which is a comprehensive way to check the soundness of platform's content. After contributor request, the content moderator chooses one of the auditors with related specialty randomly to audit the content. If the auditor accepts the invitation, he proceeds to the submitted content checking. Afterwards, the auditor sends the content back to the contributor with the proposed modifications. When the contributor makes the appropriate modifications, the auditor gives his approval for the content to be published as audited. If an auditor rejects invitation, another auditor is chosen.

Moderation. Culture Gate uses a decentralized model to administer platform content and everyday use. Administrator chooses the users that will become moderators from a pool of registered users that have shown interest for this role. According to the assigned duties (like monitoring disciplines or contributed content), the administrator gives the corresponding elevated permissions. For example, if a user is chosen to become a content

moderator, the administrator will allow him to moderate contributions, create private user groups or ban users, but he will not be able to moderate content assigned to another moderator.

Registered User Public Content Uploading and Managing. A registered user is permitted to upload cultural content through the "Add Listing" screen. Users contribute content filling out fields like title, description, discipline, featured image, multimedia files, location, date or keywords. Users can click the "Review your Listing" button and see the way the content will be displayed. If the content is compliant to platform's terms and conditions, the information is being published. When the uploading procedure terminates, the content becomes available to the public (Fig. 3).

Registered User Private Content Uploading and Viewing. A registered user that uploads content has full ownership over the content. The user can declare his content public (for everyone to see) or private (can be seen by him or a certain user group). When a registered user wants to formulate a private group to share content, in a protected manner, with other users, he informs a moderator. The user must provide a clear group description (like a class of students that implements an educational virtual tour to a museum) and a list of users who will serve as group members. The first user will be the group leader and will be responsible for the content each member of the group uploads. This content will be private and restricted only to the group members for viewing. A group member that uploads private content must declare that this content is only available for the group members.

Mobile Based Scenarios. CGMA offers an extremely useful functionality to scientists of cultural heritage, especially those working in the field. These experts can capture tangible and intangible cultural content and store it immediately and easily to a web server. This procedure gives them the opportunity to secure their findings, digitize content and preserve it, share their content with colleagues in real-time and exchange information with them. Every new finding, is enriched with several other information, automatically, like the coordinates of the location that the discovery have been made and annotations about the finding that enrich the content of the discovery.

Field Use - Archaeological Excavation Site. A team of archaeologists works on an uncharted area. At least one member of the team has an android smartphone with CGMA installed in it. This smartphone must have an internet connection when CGMA is being used. The user clicks and opens the application. If he has already used the application or has an account, he can sign in immediately. Otherwise he must register using the "Sign Up" screen (Fig. 6) submitting username, password, email and discipline. After signing in the system, the user navigates to "Field Functionality" screen (Fig. 7) and submits contribution title, description and the concerning discipline (in this case "Archaeology"). User can take a photo, record video or audio. When the user clicks the "Send Cultural Data" button, the system sends the collected data along with the excavation point's geographical coordinates to the web server.
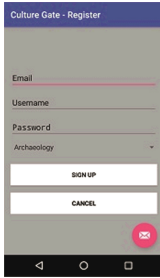
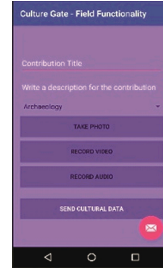**Fig. 6.** CGMA "Sign Up" screen   **Fig. 7.** CGMA "Field Functionality" screen

Indoor Use - Museum School Visit. A class teacher decides to visit the city museum with his students and communicates with a moderator in order to create a private user group for the class, with him as a group leader. Moreover, he asks from every student to install CGMA to their smartphones and create accounts. The teacher informs the moderator about the user accounts to be added to the user group. When the class visits the museum, the teacher informs the students to sign in Culture Gate and navigate to "Indoor Functionality" screen and start using CGMA's indoor service. He consults them to capture artifacts, make notes stating their point of view and send them to Culture Gate. The teacher can use CGMA to record an audio file with museum's conducted guide. When the visit is over, the teacher accesses the content contributed by students and reviews it. Then, he publishes the content with visibility only to group members. In the next lesson, he will be able to discuss this museum visit with the students and publish the corresponding virtual tour to the public.

Street Use - Cultural Event. A user is watching a religious ceremony in a city street. The user signs in the system and navigates to the "Street Functionality" screen. In order to capture a video he must submit title, description, discipline and click the corresponding button to capture a video. After the video is recorded and stored to the smartphone, it is ready to be transferred along with geographical coordinates to Culture Gate web server by clicking the "Send Cultural Data" button (Fig. 8).
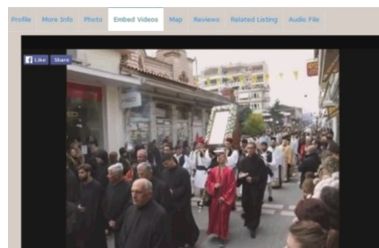

Fig. 8. Religious ceremony in Arta, Greece – video capture

6 Discussion and Future Work

In this work we address the problem of provisioning digital tools that support public participation in evolving cultural projects. Digital tools are implemented through a participatory platform where users collect and disseminate cultural information. Since May 2016 the platform is accessible for the broad public [5]. Web portal services (content organization, viewing, searching, dissemination and user attraction) have been well - received by the rapidly growing Culture Gate Community. Most of platform's core services (access control, registration, moderation, authoring, group formation, personalization) have been successfully implemented and tested, except issues related to intellectual property, which are in design phase. Concerning CGMA, we distributed the application to a group of application developers to express their opinion about several technical issues like network connectivity or big data uploading. Simultaneously, CGMA was distributed to cultural experts to notify us about the application's usability and user friendliness. We plan specific activities for elementary and secondary education to test the acceptance of the proposed platform as an education tool. In this direction we have already come in contact with school teachers. Those activities will give us feedback for the improvement of our system.

Alongside with the platform development strategy, we follow an operational strategy with the formulation of project teams, which consist primarily of interested cultural heritage academic students, which undertake daily tasks and help in maintaining the platform. Culture Gate could be commercially exploited in many ways as it can have a significant social impact in sectors like tourism or cultural heritage market. Museum curators can promote museum collections by uploading information about them to the platform. Tour operators or Public authorities could use Culture Gate to highlight certain cultural heritage spots and attract new clients and tourists, thus helping local and national markets. Organizers of cultural events have the opportunity to advertise their events to an immense and targeted public. Moreover, CGMA could contribute revenue in two different ways: the free version could host advertisements while a premium version with additional features could become available for downloading for a small price. In order to handle intellectual property rights we will enhance our platform with watermarking services for image, audio and video that will be available with a small fee to any contributor upon the uploading of his contribution. For images, we plan to offer a service based on a watermarking scheme that guarantees efficient and fast embedding and detection of watermarks [22]. For MP3 audio files, we will provide a service based on an algorithm that supports watermarks with semantic meaning and it is fast and reliable for online use [23]. For video files, the selection of an efficient scheme will be a goal for future work.

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