

# A Mobile Application to Personalise the Visiting Experience of Museums Cultural Heritage

Devis Bianchini, Massimiliano Garda

Dept. of Information Engineering, University of Brescia – Via Branze, 38 - 25123 Brescia (Italy)

{devis.bianchini, massimiliano.garda}@unibs.it

**Abstract**—In the latest years, the digital innovation paved the way to new opportunities for museums to showcase their cultural heritage to the audience of visitors. Remarkably, mobile applications (apps) have become powerful instruments to provide visitors with the ability of customising and enriching their experience while visiting museums. In this paper, we present a prototype app, designed and developed in the scope of an ongoing research project, aimed at offering visitors the opportunity of acquiring knowledge about artworks. In particular, the app enhances the visiting experience with personalisation and gamification elements apt to: (i) increase visitors’ engagement and promote artworks cultural heritage; (ii) offer the possibility of undertaking thematic paths, personalised relying upon visitors’ profiles.

**Index Terms**—smart cultural heritage; museum mobile application; museum thematic paths; museum gamification;

## I. INTRODUCTION

In the latest years, the digital innovation paved the way to new opportunities for museums to showcase their cultural heritage to the audience of visitors [2]. Remarkably, mobile applications (apps) have become powerful instruments to provide visitors with the ability of customising and enriching their experience, while visiting museums, further improved with personalisation and gamification features [1], [4]. In this paper, we present a prototype app which has been designed in the scope of the “Data Science for Brescia - Art and Cultural Places” research project (in brief, DS4BS) with the aim of offering visitors the opportunity of acquiring knowledge about artworks. The main contribution of our prototype consists in the adoption of personalisation and gamification elements, discussed in Section IV, apt to stimulate the engagement of visitors, promoting at the same time artworks cultural heritage. Additionally, the app allows visitors to explore the rooms of museums and their content according to different modalities, offering the possibility of undertaking thematic paths, personalised and suggested depending on visitors’ profiles. The research project, the functionalities of the app and the description of the personalisation and gamification elements are presented in the following sections.

## II. THE DS4BS PROJECT

The DS4BS project is one of the initiatives organised for the nomination of Brescia and Bergamo (Northern Italy, Lombardy Region) as Italian Capitals of Culture in 2023. The DS4BS project has the main objective of increasing knowledge about the way people visit the cultural places (e.g., museums, theatres, monuments and historic buildings) in the city of

Brescia, in order to support institutions and decision makers in the organisation of cultural initiatives, also exploiting the lesson learned in recent pandemic events [7]. One of the research lines of the project regards the quantification of the sensing experience of museums visitors, properly integrated with other information about the visitors’ movements along cultural itineraries, multimedia contents on artworks and their tailoring towards different categories of visitors. Within this research line, an objective of the project is to make information regarding artworks and related multimedia contents available through an app, in order to let visitors explore, at hand and in a digitalised way, the cultural heritage of museums. A representative museum involved in the project, the Pinacoteca Tosio Martinengo art gallery, located in the city of Brescia, has been chosen as a reference context for the design/development of the app and for the experimentation with users, the latter planned by the end of 2023. To date, the visitors of the Pinacoteca Tosio Martinengo are endowed with the possibility of exploring the art gallery through a web application lacking of personalisation elements and providing only a partial coverage for the requirements elicited in the following.

## III. MOBILE APPLICATION REQUIREMENTS

**User’s roles.** The app is targeted to two different categories of users, namely *unregistered visitors* and *registered visitors*. Through the app, an unregistered visitor obtains information regarding rooms and artworks (mainly, textual descriptions, images and supportive audios). Optionally, unregistered visitors may perform a registration procedure to benefit from personalised contents, thus becoming a registered visitor. The user’s profile is exploited to deliver a personalised exploration experience for the visitor while visiting the museum, including thematic paths compliant with her profile and gamification elements to increase the engagement and the interest in exploring the artworks of the museum.

**Use cases.** Visitors will exploit the app installed on their smartphone to acquire knowledge about artworks exposed in the museum. In the following, we report the use cases for the two roles previously described.

- *Visitor registration.* As already anticipated, the registration procedure is devoted to obtain a *profile*, and it is articulated over two distinct and mandatory phases: (i) firstly, the visitor inserts personal information (plus a valid e-mail address and password) to create a login account; (ii) then, the visitor has

to rank four motivating reasons/statements (from the most to the least important) that led her visit the museum. The ranked statements will be exploited to assign the visitor a *profile*, somehow resembling the foundations of role playing games, as explained in Section IV.

- *Free visit of the museum rooms.* Visitors have at their disposal the opportunity of visiting a museum based on a so-called *free visit* modality, that is, moving from a room to another, exploring the details and multimedia contents associated with both rooms and artworks. According to this modality, the visitor may choose to visit a specific artwork by inserting in the app the numeric identifier of the artwork or by scanning a QR-code located nearby the artwork.

- *Visit through the exploration of thematic paths.* This modality is available only for registered visitors and aims at proposing visitors *thematic paths*, grouping together artworks leveraging different criteria (e.g., historical century, type of subject of the artwork). In particular, the app suggests the visit via several thematic paths, primarily highlighting the ones that are compliant with the profile. Thematic paths suitable for the profile are identified as a result of the second phase of the registration process previously described.

#### IV. PERSONALISATION AND GAMIFICATION ELEMENTS IN THE MOBILE APPLICATION

**Assignment of a profile to registered visitors.** In the second phase of the registration process, the rank expressed by the visitor is exploited to associate the visitor with one of the following *profiles*, aimed at identifying visitors according to their artistic tastes: (i) *Aesthete*, for a visitor appreciating human portraits; (ii) *Traditionalist*, for a visitor appreciating artworks concerning daily life scenes; (iii) *Stakhanovite*, identifying a visitor loving artworks where the subjects are performing a job; (iv) *Bucolic*, for a visitor appreciating artworks with landscapes and nature scenes. To determine the profile, the app invokes an external web service, which leverages the rank given by the visitor for the execution of a Cluster Analysis algorithm [3]. Such algorithm has been devised by a team of statisticians participating in the DS4BS project and trained on the results of a campaign of questionnaires (specifically, on the answers given to a specific question, which inspired the ranking task of the second phase of the registration procedure), conducted on the visitors of the Pinacoteca Tosio Martinengo in the latest months of 2022. The description of such algorithm is out of the scope of this paper. In turn, the profile serves to identify a subset of thematic paths to be suggested to the visitor as more relevant for her interests, to start the exploration from.

**Gamification applied to thematic paths exploration.** Whenever the visitor chooses to explore artworks following a thematic path, the app tracks the visited artwork within a thematic path (at registration time, GPS location permission are requested, in order to mark an artwork as visited only if the visitor's position is within an acceptable distance from the museum). The app contains gamification elements targeted to

increase the engagement of visitors. Indeed, gamification is renowned for helping creating more immersive and personalised visitors' experiences, improving knowledge absorption and cultivating interest in learning [5]. Gamification in the app is enacted through a collection of three *medals*, corresponding to goals a visitor should achieve to obtain a reward (e.g., tickets at a reduced fare for other museums). Particularly, the goals backed by the medals have an increasing difficulty: (i) the *Base* medal is unlocked downstream the completed registration procedure; (ii) the *Intermediate* medal is unlocked when the visitor completes the visit of the thematic paths meant for her profile only; (iii) the *Advanced* medal is unlocked when the visitor completes the visit of all the thematic paths uploaded in the app.

#### V. CONCLUSIONS AND FUTURE WORK

In this paper, we described our contribution in the scope of an ongoing research project, concerning the design of a prototype app to enhance the engagement of visitors in the exploration of museums. Future work will be devoted to conduct usability tests on the prototype app with a representative group of users, also performing a thorough comparison between the web application currently used in the Pinacoteca Tosio Martinengo and our prototype app, using proper evaluation metrics (e.g., success score, number of errors) assessed on tasks common to both the applications. Moreover, as a long-term objective of the DS4BS project is to extend the employment of the app within other museums adhering to the project, two further efforts will be pursued: (i) study the integration of the prototype app, which currently relies on the cloud-based Firebase Realtime Database, with a Data Lake repository [6], to collect data from heterogeneous sources of museums; (ii) predispose additional use cases (e.g., to let visitors compile questionnaires on their visits directly into the app), also envisaging contents and functionalities meant for children.

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