



Digital technologies for accessible and sustainable cultural tourism. A project for the enhancement of Baroque Turin routes

Roberta Spallone^a and Marco Vitali^b

^aDepartment of Architecture and Design, Politecnico di Torino, ; ^bDepartment of Architecture and Design, Politecnico di Torino, , marco.vitali@polito.it.

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Abstract

This contribution follows previous research about the recognition and geometric and morphological analysis of more than 70 Baroque atria covered by unitary and complex vaults in Turin city centre, the digital survey, and the AR experiments aimed at the presentation of the research's results.

The current proposal aims to communicate, spread, share, and finally, involve the community in the safeguarding and valorising of Architectural and Urban Heritage in Turin.

Turin Baroque atria are little known and rarely visited by the public, especially if intended as a system. This led us to think of creating thematic routes with a focus on accessibility and sustainability and dedicated not only to specialists but also to citizens, making them aware of and part of a common heritage and to the tourists looking for unusual cultural itineraries.

A dozen thematic paths aim to give back the complexity of the Cultural Heritage under investigation by linking the knowledge involved to allow different and personalised visit experiences concerning the type of user and his interests.

Keywords: digital technologies, accessibility, sustainability, cultural tourism, Baroque Turin.

1. Introduction

This contribution follows the author's previous research about the recognition and geometric and morphological analysis of more than 70 Baroque atria covered by unitary and complex vaults in the Turin Historic Centre (Spallone & Vitali, 2017a). The subsequent stages of the research involved the proposal of a route for tourists interested in mathematical disciplines (Spallone & Vitali, 2017b), the digital survey of a selection of the atria considered, and the experimentation of augmented reality (AR) for the communication and inclusive use of the cognitive content collected during the study phases. The latest activities were carried out in the ambit of the project "Nuevas tecnologías para el análisis y conservación del patrimonio arquitectónico" funded by the Ministry of Science, Innovation and University of Spain, which allowed Concepción López González (UPV) to join the Politecnico di Torino research group (López González et al., 2020; Spallone et al., 2021), and the AR experiments conducted in collaboration with Valerio Palma (Palma et al., 2019), from Shazarch, a start-up devoted to digital solution for heritage.

The current proposal aims to communicate, spread, share, and finally, involve the community in the safeguarding and valorising of Architectural and Urban Heritage in Turin. Digital technologies are involved at every stage of the process, from analysis through digital survey to interpretation through 3D models to communication and fruition through web, AR, and VR.

Between the 17th and 18th centuries in Turin, a highly innovative architectural season emerged, which, in the field of civil architecture, demonstrated unprecedented, pleasing spatial configurations for access and distribution spaces of noble buildings, conceived as a spectacular fulcrum at the acme of the ceremonial entrance. The atria realised with such spatial schemes present unified spaces without intermediate pillars, covered by composite vaults made of brickwork masonry. These were characterised by a remarkable geometric complexity, which gave them dynamism and airiness, allowing, at the same time and whenever necessary, the use of rather small rises (Figure 1). The interest in these spaces has been evidenced, among others, in the pages by Norberg-Schulz (1980) dedicated to the late Baroque palace, in which the Turin solutions are widely described.

Such a model of atria, in its extensive diffusion, is also of particular importance as a typical phenomenon of the city of Turin. The particular architecture with "open structures", so well highlighted by Pommer (1966), found extraordinary diffusion in Piedmont and Turin and prospered during the second half of the XVIII century also, contrary to other Italian and European realities where in the same years we are witnessing the return of soberer forms taken from the classical and sixteenth-century tradition.

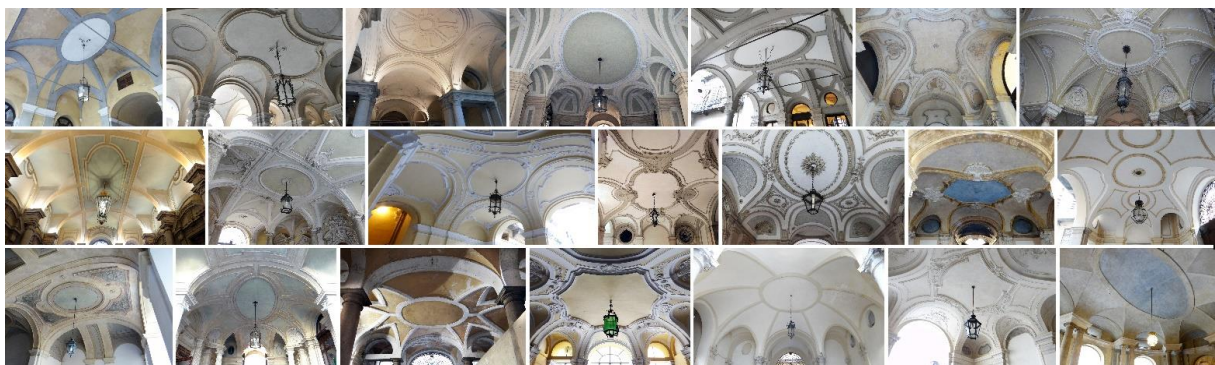


Figure 1. Overview of Baroque atria in Turin. Author: M. Vitali.

2. The Project

Through deep historical, morphological, and architectural analyses of the above-mentioned atria and an interpretive synthesis, it is possible to recognise and propose several cultural and touristic paths, which led to the hypothesis of a different fil rouge of connection between one atrium and the other. This last aspect makes it possible to imagine routes within the historical city. This led us to think of creating thematic routes dedicated not only to an audience of specialists, but also to

citizens, making them aware of and part of a common heritage, and to the tourists who, more and more, are looking for unusual cultural itineraries. Therefore, it is a Cultural Heritage of great interest and a local peculiarity, but it is little known and visited by the public, especially if intended as a system.

This project is conceived and defined with a high level of scalability, not only related to other architectural heritage (e.g. industrial archaeology, modernism architecture...) but also to different kinds of Cultural Heritage, material and immaterial (e.g. museums, archives, theatrical representations, musical performances...). This means that research products could be the subject of future developments within the framework of partnership agreements, triggering a positive impact on the territory and fueling the initiatives of Territorial bodies.

The outcomes of the project consist of the creation of smart touristic routes enhanced by a website and a web app whose use will be strongly integrated. The website could link with Museo Torino, the digital museum of the city, which collects most of the city's documentary heritage.

All these topics are intertwined with mobility, in the specific case mainly pedestrian (but also with a possible look at public transport and sharing of vehicles) and digital education, to which the project could contribute, also involving different age and cultural background groups in the creation of device interfaces. Objectives of inclusiveness imply attention to the realisation of a pilot route and the development of tools and special sections of the website and web app for accessibility related to: mobility, visually impaired, blind, and hearing, in desirable connection with existing apps.

The overall objective of cost containment will guide the research, thanks to: Low-cost devices (Mobile first), Low-cost Solutions, and Free and Open-Source Software.

At the current phase of the project development, the thematic paths have been created, and the first one is adjustable from the accessibility point of view.

3. The State of the Art

In recent years, the rapid development of low-cost digital devices and technologies for heritage communication has massively affected sustainable tourism. In particular, the field of eXtended Reality (XR), which includes augmented, virtual, and mixed reality, is today demonstrating its potentiality with respect to the continuum between real and virtual that characterises our daily life.

Among the extensive scientific literature that has recently related sustainable tourism to the latest AR and VR technologies are reviews by Cranmer, tom Dieck & Jung (2023) and by Talwar et al. (2023).

The first deals with the role of augmented reality for sustainable development in the scope of Cultural Heritage tourism and reveals that AR presents strategic opportunities to achieve social, economic, and environmental sustainability.

The second noticed the heightened activity in VR tourism, which has been touted as “alternative tourism” and “eco-tourism”, during the COVID-19 pandemic and wonders if this shift is temporary or will persist after the pandemic is over and concludes theorising VR tourism as a sustainable tourism solution long into the future.

Among the case studies, we could mention two studies that take stock of issues related to the use of AR and aim to enhance Cultural Heritage, including tourism experiences. They favour and support guided tourist experiences through the implementation of itineraries and visiting routes, linking the application of the AR to specific elements of a widespread heritage that provides anchorage mechanisms that do not rely on markers. The first work bases on the real-time visualisation of computer-generated virtual content (models, drawings, and documents) on mobile devices such as smartphones and tablets and systematises the main issues and challenges and some of the latest trends in the search for simple and accessible solutions without the use of too advanced tools, such as the development of new marker-less systems that uses local feature-based image registration and structure from motion (SfM) technology (Sato et al., 2016). The second work constitutes a specific experience of the application of AR for the construction of one complete mobile tourist guide for the enhancement of Cultural Heritage sites

located in the old town of Chania, Crete, Greece (Panou et al., 2018). The experience appears particularly interesting for the opportunity to interact with historical monuments in non-intrusive ways, and for the aim to provide for future additions of digital content with a moderate amount of development and technical expertise. Moreover, one aspect that we consider particularly important is linked to the possibility for users to give feedback on their visit and to share information and experiences with other users.

4. Aims and objectives

The project intends to follow some of the 2030 Sustainable Development Goals (SDGs) defined by the UN. In particular:

SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all, Target 8.9: By 2030, devise and implement policies to promote sustainable tourism that creates jobs and promotes local culture and products;

SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable, Target 11.4: Strengthen efforts to protect and safeguard the world's cultural and natural heritage;

SDG 12: Ensure sustainable consumption and production patterns, Target 12.b: Develop and implement tools to monitor sustainable development impacts for sustainable tourism that create jobs and promote local culture and products.

Concerning local actions framed in the “Agenda Digitale della Città di Torino” – Digital Agenda of the City of Turin –, issued in 2016 and whose time horizon refers to the Strategic Plan “Torino Metropoli 2025” – Turin Metropolis 2025 – this project can contribute to the participation and inclusion of citizens in the life of a smart city, which cannot ignore a progressive growth of digital skills. These will be facilitated through mobile devices, tablets, and PCs for Cultural Heritage fruition, to accompany users and increase their ability to interact online and use the tools in an informed way. Furthermore, the concepts of “culture” and “digital innovation” expressed in the Agenda are fully shared and preserved in the project. In the project, culture represents a prime factor in the development of the territory, based on its enhancement, in addition to its protection. It allows citizens to benefit from a heritage that is common and needs to be communicated. The project develops this concept on architectural artifacts diffused throughout the central area of the city, whose value as a system is affirmed beyond that of individual monuments. As said, the consistency and artistic quality of this system are little known today. The re-discovery, the construction of personal cognitive paths, and those provided by the research team can fuel in the citizenship the sense of belonging and active participation in the safeguard and lead to the triggering of crowdfunding and crowdsourcing initiatives.

Waiting for the Turin Metropolitan Strategic Plan 2024-2026, the current plan 2021-2023 “Piano strategico Metropolitan di Torino” called “Torino Metropoli Aumentata” – Turin Augmented Metropolis – in the Line 1, Digitisation, Innovation, Competitiveness and Culture, Strategy 1.5 is promoting the enhancement of the territory's potential for tourism promotion and fruition thanks to new technologies, both in terms of direct communication to new media and in terms of material and immaterial accessibility of the metropolitan territory's tourism products.

The challenge, therefore, is to create a “value chain” of attraction, allowing the city of Turin and the metropolitan area to make the city's “heritage assets” available and accessible: tangible ones (landscape, urban space, culture, art, products and brands, services, skills of its inhabitants) but also intangible ones, that is, information assets and IT assets. In this way, we will promote and witness a momentous passage, that is, the transformation of the “public heritage”, including the cultural one, into the “common good”. Such a transformation will define an interesting, accessible and usable resource, promoting at the same time the dynamics of active participation in the protection and enhancement of this heritage (e.g. through the activation and promotion of social ways of finding resources and funds for cultural and tourism projects).

5. The paths

The creation of on-site visit paths offers users different thematic itineraries, to specific interests.

At the moment, a dozen thematic paths have already been structured, which aim to give back the complexity of the Cultural Heritage under investigation by linking the systems of disciplinary knowledge involved (history of architecture, drawing, and three-dimensional digital representation, construction technique, etc.) to allow different and personalised visit experiences concerning the type of user and his interests. These paths are oriented to the deepening of specific themes.

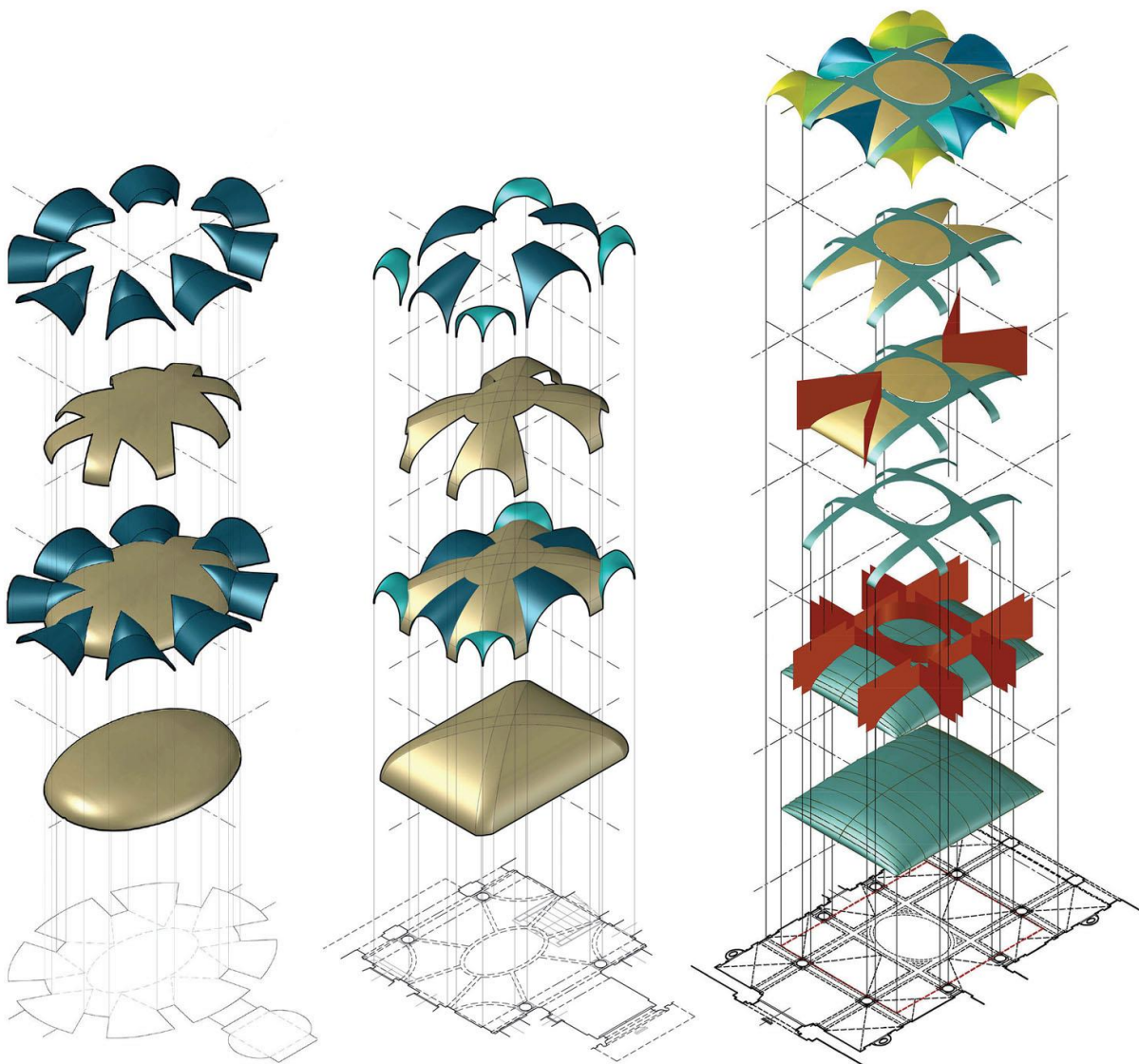


Figure 2. Geometric Analysis of Star-shaped (Palazzo Carignano), Planterian (Palazzo Cigliano) and Banded vaults (Palazzo Coardi di Carpenetto). Palma, et al. (2019).

For example, paths have been envisioned related to:

- the transformation over time of the entrance and distribution spaces of the noble palaces of the city centre (Path 1: “The atria of the Baroque era in Turin: complex unitary vaults as a Cultural Heritage”) developed concerning: (i) the evolution of construction techniques; (ii) the changes in requirements linked to the entrance ceremonial; (iii) the changes in architectural taste;

- the architectural production linked to a specific period in the wider reference time-frame or a single type of vaulted atrium (Path 2: “Star-shaped vaults”; Path 3: “The planterian formula”; Path 4: “Banded vaults”);
- the production of a specific author (e.g., Path 5: “Guarino Guarini and his epigones (Gian Francesco Barocelli, Michelangelo Garove)”; Path 6: “Gian Giacomo Plantery and planterian vaults”; other paths may be structured on architecture masters as Amedeo di Castellamonte Filippo Juvarra, Bernardo Vittone, etc.);
- the relationship between complex vault shape, geometries, and decoration (path 7: “Geometry, shape, and decoration: a relationship not always taken for granted”), between their construction techniques and their structural behaviour (Path 8: “Shape and structure: north-west path”; Path 9: “Shape and structure: south-east path” (Figure 2);
- the relationship between the urban transformations of the baroque city and the diffusion of atria with homogeneous characteristics (e.g., Path 10: “The ‘dirizzamento’ – rectification – of via Dora Grossa”; other paths may be structured concerning the diffusion of the different types of atria in the areas of the historical centre and the realisation of the three baroque enlargements of the fortified city walls or to the important reshaping interventions in the minute fabric of the historical city, etc.);
- unusual atria, which emerge from a homogeneous panorama of models established in relevant buildings and repeated according to a ‘fashion’ (Path 11: “Singular atria”);
- digital reconstruction of atria (in their totality or only partially) that no longer exist today or have been heavily transformed, fragmented, or hidden by superfetations (Path 12: “C’era una ‘volta’ ” – once upon a time –).

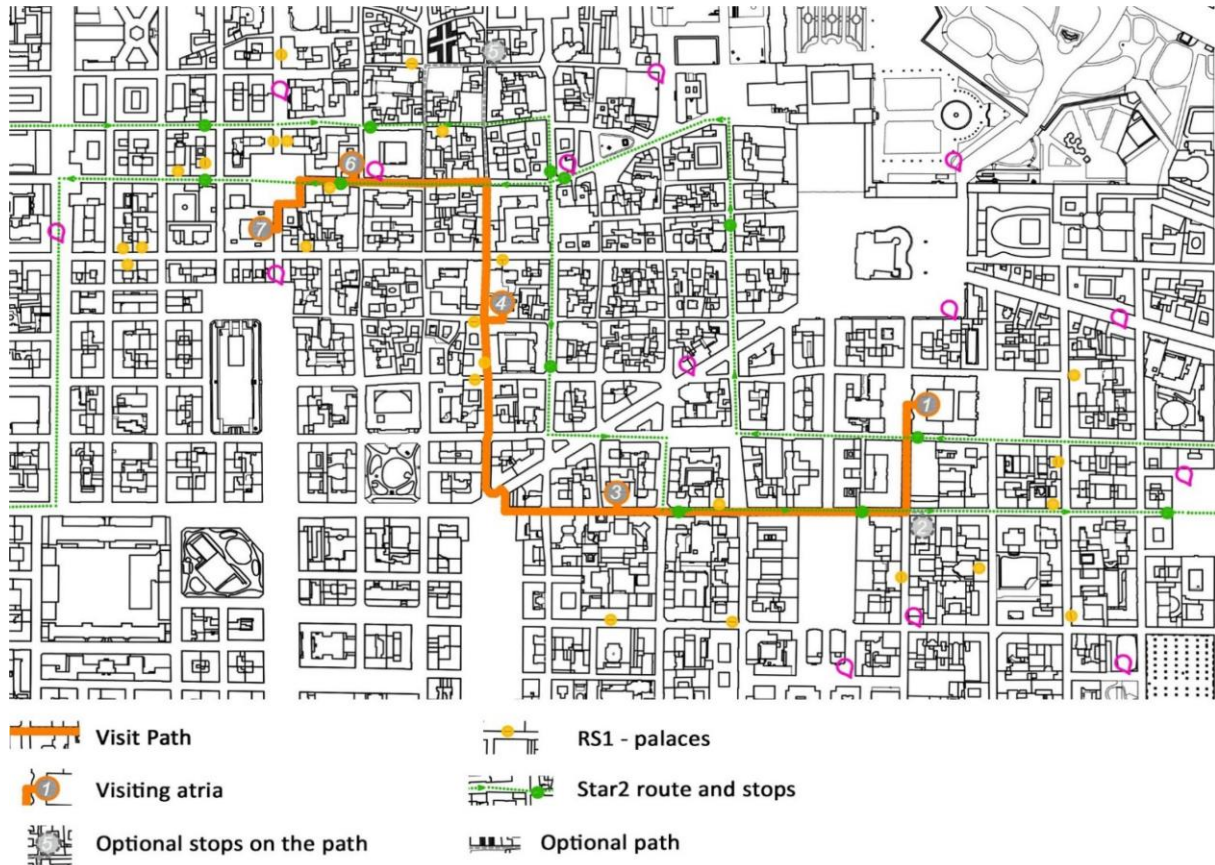
All the paths have been studied to guarantee the visitor to lead an architectural walk in the fabric of the historical city, customisable and intended both as single and sequential experiences, concerning:

- time available for the visit (some of the buildings may or may not be included in the itinerary without changing its purpose, as well as specific contents related to each atrium may or may not be activated to vary the duration of the stay in each building);
- to the different availability of walking, updating the length of the route according to the different customisations, and including in the map the most significant public transport routes (e.g. Star 2 line provided by electric minibuses);

In addition, the contents that could implement a recommendation system concern: 1– atria belonging to the same Cultural Heritage; 2– museums and visit routes inside the building, archives; 3– bookshops, historical shops, and cafés.

Concerning the issue of disabilities, the project aims to structure entirely one of the proposed paths, taking into account motor and sensory disabilities, to ensure appropriate routes for people with motor disabilities and to provide the web app contents structured for people with sensory disabilities.

For demonstration purposes, the full description and map of the “basic” route of the project, path 1 (“The atria of the Baroque era in Turin: complex unitary vaults as a Cultural Heritage”), conceived as a first approach to the system of Baroque unitary vaults in Turin (the most general and representative of this Cultural Heritage as a whole).



1. **starting point: Palazzo Carignano** –Piazza Carignano 2 (Recommender system (RS) 1: Palazzo Bogino – Via Bogino 8, Palazzo Baroni di Tavigliano – Via Bogino 31, Palazzo Graneri – Via Bogino 9; RS2: Museo del Risorgimento, Appartamento di mezzogiorno, Appartamento di mezzanotte, Biblioteca nazionale; RS3: Luxemburg Bookshop, Burlot Antiques bookshop, Gilibert gallery, Calderan Antiques, del Cambio Restaurant, Mulassano Historical café, Baratti &Milano Historical café, Carignano theatre, Circolo dei Lettori);
2 min walk (200m)
2. **Palazzo Asinari di San Marzano** – Via Maria Vittoria 4 (optional stop) (RS1: Palazzo Birago di Borgaro – Via Carlo Alberto 16, Palazzo Isnardi di Caraglio – Via Lagrange 6, building in via Maria Vittoria 19*; RS3: Guido Gobino Chocolate shop, Eataly, Stratta café, *Turismo Torino);
5 min walk (400m)
3. **Palazzo Provana di Collegno** – Via S. Teresa 20 (RS1: Palazzo Riche di Coassolo – Via S. Teresa 10, Palazzo Galleani di Canelli e di Barbaresco – Via Alfieri 6, Palazzo Valperga di Masino – Via Alfieri 18),
6 min walk (450m)
4. **Palazzo Cigliano** – Via Barbaroux 28 (RS1: Palazzo Capris di Cigliè – Via S. Maria 1, Palazzo Perucca della Rocchetta – Via Barbaroux 25, Palazzo Villanis – Via Botero 8, Palazzo Durando di Villa – Via Garibaldi 23; RS2: Historical Archive of Turin; RS3: Tamborini café, Venier pastry shop),
5 min walk (400m)
5. **Palazzo Novarina** – Via S. Chiara 8 (optional stop) (RS1: Casa Martino Monteu Beccaria – Via S. Chiara 20, Palazzo Mazzonis (MAO) – Via S. Domenico 11; RS3: AL Bicerin café, Barolino Cocchi café, Consolata herbalist's historical shop),
4 min walk (300m)
6. **Palazzo Barolo** – Via delle Orfane 7 (RS1: building in Via Corte d' Appello 13, Palazzo Martini di Cigala – Via della Consolata 3, Casa d'affitto dell'Orfanotrofio – Via della Consolata 8; RS2: Palazzo Barolo museum, Palazzo Barolo Historical Archive, Archivio di Stato – Sezioni Riunite; RS3: Levi Aprile Historical stationery shop, Peyrot Antique Bookshop),
4 min walk (300m)
7. **Palazzo Saluzzo Paesana** – Via della Consolata 1bis (RS1: Palazzo Fontana di Cravanzana – Via Garibaldi 28, Palazzo Cotti di Brusasco – Via Bligny 5, building in Via del Carmine 4, building in via Garibaldi 38, building in Via Garibaldi 40, building in Via Garibaldi 53; RS2: Palazzo Saluzzo Paesana – cultural events and apartments.

Figure 3. Path 1: “The atria of the Baroque era in Turin: complex unitary vaults as a Cultural Heritage”. M. Vitali.

6. Future development

The virtual visit will be based on the collection of textual, iconographic, and interpretative materials through a dedicated website which could be linked e.g. with MuseoTorino website, with the TurismoTorino website, and other cultural tourism-dedicated websites, including those dedicated to accessible tourism. It could also imagine the link with Archivio Storico della Città di Torino and Archivio di Stato di Torino, which kept iconographic and textual documents about the historic city. Finally, the website in project could be able to collect visitors' feedback, through comments, photographs, videos, shared by them.

As anticipated, using the tools offered by the digital revolution, we intend to work in the direction of an enhancement, valorisation, and sharing of the Cultural Heritage, mixing and merging real and virtual documentary materials and fruition experiences. This will happen during the on-site visits using a mobile device app that will enable object recognition processes, tracking, and AR applications.

In particular, during on-site visits, webAR will enable the display of information (also through the connection to the website) through portable devices. The information, for example, will consist of short descriptions, iconographic documents, bibliographic references, and links to the historical context, diagnostic analyses, geometric models of the vaults, BIM models, survey drawings, results of diagnostic, and structural analyses. Not all the atria of the palaces included in the paths are accessible because some of them are private buildings and, in any case, are subject to specific opening hours. For this reason, the recognition and tracking of information can take place within the atria or through the facade elements of the buildings, in the latter case, carrying out a particular exploration of digital models.

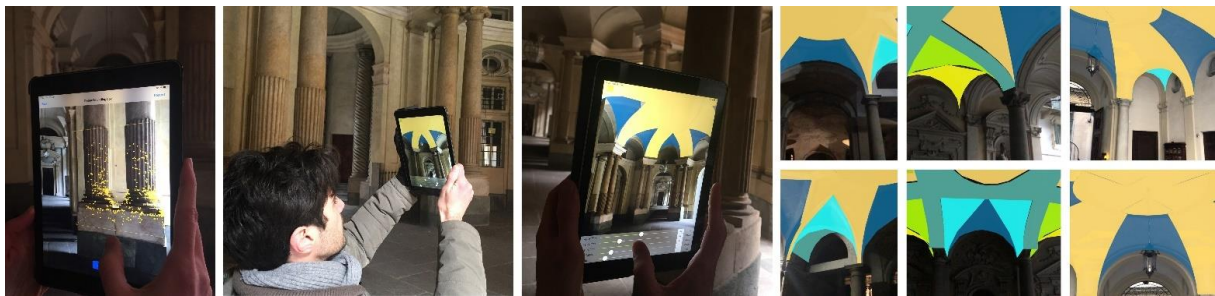


Figure 4. AR experience in Turin Baroque atria. Source: Palma et al. (2019)

7. Conclusions

This contribution presents the construction of cultural routes in the centre of the city of Turin, aimed at sustainable tourism and attentive to motor and sensory disabilities. The rapid and continuous development of digital technologies to support heritage communication is the focus of the author's attention so that when the project is ripe for the development of webAR and VR, and today in a broader sense of eXtended Reality (XR) modalities, the dissemination of architectural heritage, cultural occasions, and related intangible assets will be implementable, updatable and connectable to institutions, associations, stakeholder groups.

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