HerMeS: HERitage sMart Social mEdia aSsistant

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Abstract. This paper presents the HERitage sMart social mEdia aSsistant (HerMeS) project, funded by Regione Lazio and aimed at offering tools and innovative services to favour the fruition of (tangible and not tangible) Cultural Heritage in the Lazio region through advanced AI and ICT methodologies and technologies. This is the first report to illustrate to the community the newborn tool starting with a survey of the main exploration and sharing of tourist-cultural content Apps to outline its innovative features and its design.

Keywords: cultural heritage · artificial intelligence (AI) · user behaviour · user experience · storytelling · participation in Cultural Heritage

Introduction

The HerMeS (HERitage sMart social mEdia aSsistant) project is developed through the collaboration of Istituto di Scienze del Patrimonio Culturale (ISPC), Istituto per l'Analisi dei Sistemi ed Informatica "Antonio Ruberti" (IASI), Istituto di Scienze e Tecnologie della Cognizione (ISTC), and DigiLab Centro interdipartimentale di Ricerca - Università La Sapienza. The project was elaborate starting from tech specialization mapping edited by Invitalia. All plan is coherent with Horizon 2020, with the Smart Specialisation Strategy or Lazio region and the framework of smart Specialization Platform (S3 Platform), which answers to one of the ex-ante conditionality for the 2014-2020 programming cycle set by the

L. T. De Paolis et al. (Eds.): XR Salento 2023, LNCS 14219, pp. 107–126, 2023.
https://doi.org/10.1007/978-3-031-43404-4_8

European Commission in order to achieve the objectives of smart, sustainable and inclusive growth set by the Europe 2020 Strategy.

The idea of creating a social platform where cultural content is generated, described, and uploaded by the same users, according to a paradigm that has been successful in other areas (such as Wikipedia), represents an innovative approach especially when combined with algorithms of artificial intelligence able to propose personalised itineraries in time and space. Within the project, the socialization of the cultural experience is combined with the development of Artificial Intelligence (AI) technologies, which represent the core of the framework. Indeed, AI makes it possible to combine numerous variables to offer tourists and visitors personalized itineraries over time and space, respecting specific needs, needs, and interests.

The HerMeS project aims to build a new application for smartphones with different target users, i.e. tourists, citizens, economic operators, and public administrations. The HerMeS application is designed to meet different needs by pursuing a bottom-up approach: HerMeS provides a collaborative framework where different actors are able to share experiences, feedback, services, and advanced tools. In fact, the planned platform allows registered users to create multimedia content and share information on specific points of interest. At the same time, the identification of visitors' interests and needs permits economic operators to define targeted intervention strategies and the Public Administration to develop solutions for local growth. The project intends to prepare analysis tools to contribute to the sustainable and inclusive development of the territory, according to national and supranational programmatic guidelines.

HerMeS aims to create a prototype of the mobile APP, currently designed and in part developed. In this paper, we present the results achieved so far.

1 Co-Creation Experiences in Tourism Field

A growing number of studies have examined the crucial role of co-creation in the context of tourism. These theoretical and empirical analyses were focused to reveal the foundational elements of active co-creation and interaction with the *Explore* features in shaping the tourist experience.

The touristic sphere encompasses behaviours and psychological aspects associated with experiences before, during, and after travel. The following sections aim to identify and examine the key dimensions that play significant roles in this process.

These dimensions have been identified in the literature and will be discussed in greater detail [3]:

- Pre-travel Stage: This dimension focuses on the activities and decision-making processes that occur before embarking on a trip. Tourists may actively seek out recommendations, read reviews, and engage with online platforms to co-create their travel experiences [2].
- During-travel Stage: This dimension pertains to the actual experience of being a tourist. It involves interactions with the destination, service providers, and

other tourists. Co-creation happens through various activities such as participating in guided tours, engaging in local culture, trying new cuisines, and providing feedback to service providers [18].
– Post-travel Stage: Following the travel experience, tourists engage in reflection and express their experiences through various channels, including social media, travel blogs, and online reviews. This dimension focuses on the post-travel activities of tourists and examines how their actions contribute to the co-creation process by sharing opinions and recommendations with others [9].

Within each dimension, several key factors are expressed in the co-creation process:

– Personal Motivations: Tourists' motivations, needs, and expectations shape their engagement in co-creation activities. Preferences for adventure, cultural immersion, relaxation, social interactions, or educational experiences vary among individuals, influencing their co-creation engagement.
– Social Interactions: Interactions with locals, fellow tourists, and service providers play a crucial role in co-creating tourist experiences. Positive social interactions enhance satisfaction and contribute to the overall travel experience [16].
– Technology and Social Media: The use of technology and social media platforms have revolutionized the co-creation process in tourism. Online platforms enable tourists to access information, share experiences, and engage with others, empowering them to co-create their travel experiences in real-time.
– Cultural and Environmental Factors: Cultural and environmental aspects of a destination influence co-creation. Tourists actively engaging with local culture, traditions, and practices contribute to the co-creation of unique experiences.

These key factors interact within each dimension, shaping the co-creation process and ultimately influencing the quality and satisfaction of the tourist experience.

2 Representing, Learning and Personalizing Touristic Itineraries

In this section, we will introduce a series of components integrated to build the HerMeS core functionalities. In particular, we will present the general concepts considered to implement an AI system realizing the recommendation process for generating personalized touristic itineraries and the basic concepts leveraged to represent the available data about the cultural places that the HerMeS system is supposed to manage.

2.1 Representing Information About Places and Users to Recommend Personalized Itineraries

One of the main objectives of the project is to design and develop a system based on Artificial Intelligence (AI) techniques to propose personalized tourist

itineraries to users, tourists and visitors, considering their different needs, preferences and interests. To this aim, when considering a specific area, the AI system will be equipped with a Knowledge Base (KB) that collects information relating to: the **Point of interests**, their history, their characteristics, the touristic services present and all the relevant aspects for their use; the **users**, their interests and preferences and past experiences also considering the possible acquisition of information from their social profiles like, e.g., Facebook, Twitter, etc.

The General Approach. The AI system will therefore leverage this information to feed a recommendation mechanism with the aim of offering to a specific user who wants to visit a certain area a series of points of interest and a *narrative* that connects them, thus proposing an experience that is linked to the user's interests but also proposes characteristic and specific (not necessarily mainstream) elements of the places to visit.

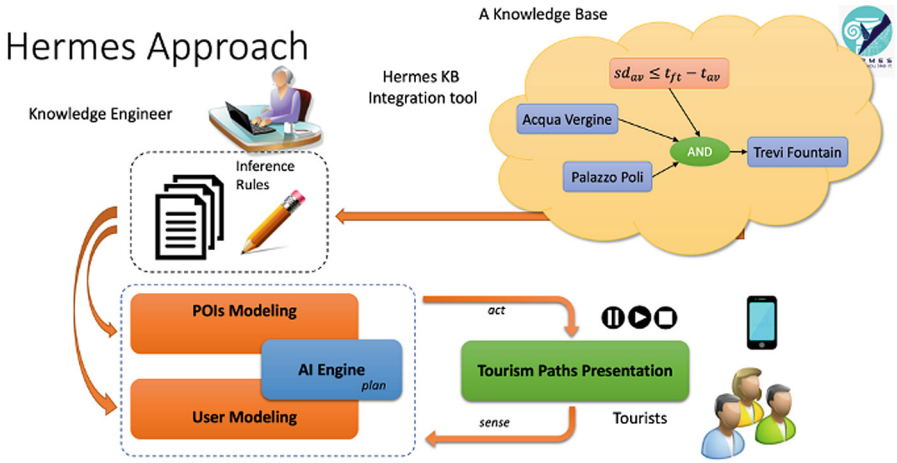

Fig. 1. The AI-based approach to generate personalized touristic itineraries.

The general approach pursued for the AI system is depicted in Fig. 1. A Knowledge Base collects all the information related to points of interest (POIs) and user profiling. Through a set of inference rules and contexts (see more details in Sect. 3) it will be possible to construct a symbolic description of a content recommendation problem considering POIs and a solution generated by the AI system constitutes the personalized path that can be presented to users, e.g., on mobile devices through an APP. The KB was defined considering the works present in the state of the art relating to the representation of information relating to cultural heritage and other tourist aspects. On User Modeling, a user profile mechanism will then be defined with the aim to classify the users characterizing their profiles according to their interests, preferences and needs. This will be implemented considering machine learning techniques applying them to data generated by the users while using the HerMeS system as well as considering

information available on social applications. Therefore, the selection of the contents to be considered for the definition of the contents/themes to be presented will constitute the actual algorithm for generating personalized paths.

Temporal Planning Techniques to Synthesize Itineraries. Itineraries are built through AI task planning technology to support the combinatorial reasoning capabilities necessary to take into heterogeneous constraints of a visit (e.g., time, geographic layout, users' interests). In particular, the planning system is able to synthesize itineraries that are coherent with respect to users' interests (personalization) and feasible with respect to the time available for the visit (i.e., the duration of the whole visit and the time estimated for the visit of the single POIs). For this reason, task planning and scheduling capabilities of HerMeS rely on the timeline-based paradigm formalized in [8]. A timeline-based specification consists of a number of *state variables* that describe possible behaviors of domain features to be controlled over time. A state variable is represents states or actions the feature can assume or perform over time; a transition function specifies the valid temporal sequences of values for each single feature; a duration function associates to each value a lower and upper temporal bounds for its execution (i.e., duration bounds of the visit); the specification allows to consider values whose temporal execution is fully *controllable* (i.e., its duration is predictable) and *partially controllable*(i.e., its duration is unpredictable). The above model has been already leveraged to realize intelligent tools for personalized fruition of cultural heritage [7].

In the considered scenario, state variables are organized in a hierarchical way. A high-level goal represents the request of synthesizing a visit for a given user. A goal is enriched with parameters denoting the duration of the whole visit and the topics to be considered while selecting the relevant POIs. A goal is decomposed into a number of *visit actions* targeting selected POIs. The timeline-based model in particular considers different state variables each representing the visit of POIs with different levels of detail and duration. The capability of explicitly representing visit actions with different duration and detail allows the planning systems of making decisions that find a good trade-off between the time available for the visit and the optimal level of detail. The correlation between the high-level goal, the underlying visit actions and the different levels of abstraction are modeled through synchronization rules.

2.2 From Cultural Objects to Cultural Places

A working group at DigiLab - Sapienza University has primarily addressed the conceptual and logical design of Cultural Objects, i.e. the cultural structure of the contents that will be generated by users of the social platform, in order to train and provide indicative parameters to the artificial intelligence envisaged by the project. In order to better define the cultural relations, which are connected with the territorial and economic context, and of possible impact, it was decided to pass from the definition of "Cultural Object", centered on the singularity of

the object, to "Cultural Place", a container minimum information in which to decline properties and relationships of an identity object.

Starting points for such definition were: not considering individuals as a basic element, but identity complexes: thus we pass from the concept of single Cultural Object to complexity of the Cultural Place (CP); how to categorize cultural places; definition the territorial/thematic relationships between the different cultural places; keeping in consideration intangible heritage and understand how to integrate something intangible into a defined space; how to define iterations with economic operators; how to manage the intersections with infrastructures, considering transport and the ways of using the routes.

Particular attention was given to the spatial development of the hierarchy, thinking *by places* and no longer *by objects*, in addition to architectural forms, points of interest, landmarks (meeting points, significant traces for the local population) that have shaped it plastically.

Once the CPs were identified, scalar aggregation units of the CPs were established as simple agglomerations, which can be defined as "monumental units", which in turn can be aggregated into scalar macrosystems, capable of expanding the contextual ramifications of the CP in increasingly complex aggregations: monumental complex, topographic unit, topographic complex, territorial unity.

Each aggregation phase, from the micro-conglomerate to the more complex expansion area, is defined by a footprint that characterizes it (e.g., "Monumental unit" = UM_01), and which makes every single step of the CP extension recognizable by the system. However, the survey is not limited to registering the points of interest that make up the CP, or their combination, but inserts information on the productive fabric ("Monumental Complex") and available infrastructures ("Topographical Complex") in the descriptive string.

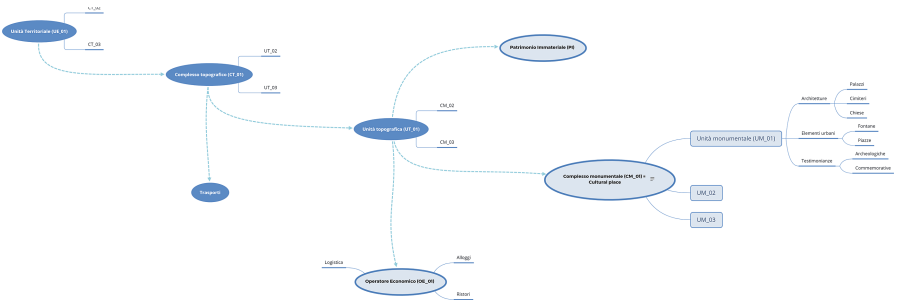

Fig. 2. Hierarchical schema to support the description and evaluation process of Cultural Places.

In Fig. n2, the characteristics of the CP: "Monumental Unit" (UM_01) are depicted. This is the minimum descriptive unit, where information relating to the POI or specific and spatially relevant aspects of the POI is collected. Architecture (palaces, churches, cemeteries, etc.), urban elements (gardens, parks, arches, towers), and testimonies (archaeological, commemorative, etc.) are to be considered

Monumental Units. Elements such as one can be defined as a Complex Monumental unit because the square contains vestiges (fountains, commemorative statues, obelisks, etc.). In the hierarchical and relational process, the aggregation of intangible heritage concerning that place must also be considered (e.g. a procession that starts from that church; the statue of Pasquino with the *pasquinate*): identifiable as PI1, which is integrated into the CP. CP/UM as a "Monumental Complex" (CM_01). Given a series of monumental units, their contextual connection (dialogue) constitutes a more articulated system, which allows the use of their compositional-architectural arrangement and their development according to a precise functionality: this articulation takes the name of "Monumental Complex". The monumental complexes can have a vertical trend. The example is San Clemente church, made up of several layers, all equally usable in their complex division of space, which generates extensive immersive environments that can be identified by stylistic features, frescoes, architectural modules: the 12th century basilica, the lower basilica (IV-XI century) the *mitreum* and the Roman road with *insula* in *opus latericium* and *horrea* from II-III AD. Each of the three layers corresponds to a monumental unit, which generates the monumental complex of San Clemente. It is therefore not the same architectural space in which they are inserted, for example. a Carolingian crypt, a Baroque chapel, or the various interventions over the centuries of an additional or innovative type placed in the same space, without boundaries.

2.3 Topographic Units (UT) and Topographic Complexes (CM)

The monumental complexes constitute a territorial network, therefore the relationships with the urban and territorial context must be considered, including those with the "Economic Operators" (OE) in this series of relationships, thus counting any presences and connections with stakeholders. Several topographical units, coherent and identifying, constitute the topographical complexes, on a larger territorial scale. Once the topographical complexes have been established, it is possible to identify from the mapping the arteries connecting the areas, the transport lines on wheels and on the railway/metro, the stops, and the parking lots, in order to allow the flow of visitors, faster movements, and more articulated and/or scalar itineraries, as envisaged among the functions of artificial intelligence to be developed in the subsequent phases of the project.

2.4 Territorial Unit (TU)

The set of Topographical Complexes corresponds to a system of congruent and narratively assimilable territorial relations. However, there is a macro-structural problem that is always inherent to intangible heritage. It may be useful for the visitor to have a general idea of the extended territory of the main and most famous intangible heritages. For example, if you have "Sabina" as a territorial unit, you might be interested in knowing that the "Festa della Fantasima" takes place in many of its municipalities, and therefore, from this general information

linked to the EU, recall the topographical units and monumental complexes where the festival takes place.

2.5 Relationships and Metadata

The hierarchical system and the structure of the database consider values to be assigned to relationships, which can include metadata and categories as well as can be assessed by users.

Therefore, descriptive strings have been devised to facilitate the recognition of the CP and its connections, and at the same time to make the contents in the search easily retrievable. The relationship that binds the different Cultural Places, in all their components and in their scalar development, consists of a string that contains all the identifying acronyms.

Relationships are the basis of the narratives that must be developed in conjunction with the various points, not so much to allow a simple union of POIs within a territorial context, as the offer of a red thread of storytelling, aimed at discovering it, involving the user in a real process of relationship with the territory: this is the radical innovation in the itineraries proposed by HerMeS, the possibility of creating "liquid" cross-country itineraries according to the chosen groupings (one-many) and the temporal measure available at the request of the visitor: 1 h, 3 h, half day, with family, with seniors. Thematic examples can be Archaeological, Architectural/Artistic, Religious, Scientific/educational, and Cultural.

2.6 Taxonomies

In order to identify the relevant taxonomies, a rather wide analysis of the state of the art considering different relationship models based on classification by: Typology (Icomonos)[1], Category (CoE)[2], Sector (France), Object (France, CNRS)[3], georeferenced Buildings (UK), Function (UK, Wall), Main Areas (UNESCO)[4], storytelling main themes(Trans Places).

Scenario 1: UM Thematic/Training CP: Palazzo del Collegio Romano. Given the list of functions of the system of Data_Heritage, selecting the voice "Training", a set of related places are shown: college, college building, observatory, museum, library, school, etc.

Scenario 2: CM thematic. Following Wales'map functionalities[5], it joins the CM "Collegio Romano", classified such as Education, adding the principal corresponding voice to the buildings and side streets present. Under Unassigned:

[1] https://www.icomos.org/.
[2] http://openarchive.icomos.org/classification.html.
[3] https://www.cnrs.fr/fr.
[4] https://www.unesco.it/.
[5] https://datamap.gov.wales.

Place Name (Piè di Marmo and Gatta); Education:Art Museum (Doria Pamphilji Gallery) and Education:Library (The Biblioteca Casanatense); Civil: Government office (MiC and Police Station); Water supply and drainage: fountain:drinking fountain:Porter Fountain; Religious Ritual and funerary:Shrine: Place of worship:Church (S. Maria in via Lata).

2.7 Evaluations

Parallel to the system of categorisation and taxonomic structuring, the existing methods of analysis and evaluation of Cultural Heritage were analyzed. In this, it was possible to make use of the previous experience of DigiLab Sapienza University of Rome, which houses an "Observatory for Cultural Heritage" and an Observatory for projects for the enhancement of cultural heritage (OsPaC[6]). In collaboration with the museums in the Municipality of Rome, the MUSE360 [4] system was developed, which provides a model of widespread restitution of the entire cultural offer and services of cultural sites, in order to optimize resources and installations. The models for the evaluation are prepared on the basis of a benchmarking of best practices at an international level. The system is modular and scalable, providing for both an expansion of monitoring issues and territorial extensions through agreements with Regions, metropolitan areas or individual cultural institutions. From this project, indications and parameters were extrapolated to analyze: online communication of assets; services for visitors; digital preservation; training; advanced technological applications; social strategies; storytelling/storyliving applied to collections/places.

The parameters for evaluating the "physical" exhibition site and local services, as well as the web presence and digital communication of the cultural institutions themselves, were prepared. The analysis of international museum experiences and specific skills in the field of cultural heritage and digital archives have made it possible to identify a series of useful indicators for an articulated evaluation of cultural institutions online and on site. More in detail, the following were examined: the types of exhibition of the collections; the activation of heritage services (location, tourism, catering, bookshop, press, publishing, job and collaboration opportunities); accessibility, usability and navigability on the web; the innovative use of technologies; Storytelling/storyliving strategies; openness to the dynamics of Web 2.0 and to collaboration with the public for the enhancement of assets; the needs and contributions of the target audience.

Thanks to this parameterize, it was possible to derive a model capable of evaluating the cultural system of the places object of the project, assigning a weight value to each parameter in relation to visitor, educational background, museum entity, relational typology.

3 A Knowledge Base for HerMeS

The Knowledge base of HerMeS should characterize a wide set of information concerning the cultural heritage of a territory. It should characterize geographic

[6] https://digilab.uniroma1.it/ricerca/course-projects/ospac-observatory.

and structural features as well as cultural qualities of tangible entities that are part of a specific territory and are relevant from a heritage point of view. However, the objective of HerMeS is not limited to the "semantic indexing" of heritage objects. A key aim of HerMeS is the representation of intangible cultural entities and their correlation with the territory and related tangible entities. A contextual representation of intangible cultural entities and the capability of correlating them to tangible entities are central to unlocking hidden relationships between places, history, religions, food, and local traditions. To characterize such a complex set of information and relationships the knowledge base relies on an ontology formally characterizing concepts and properties [12]. Specifically, we design the HerMeS Ontology as a novel domain ontology [11] extending the ontological model ArCo which was specifically designed for the Cultural Heritage domain [5,6].

3.1 The ARCO Ontology

ArCo is the result of a recent research effort aiming at publishing a knowledge graph (KG) that model the Cultural Heritage domain and a Linked Open Data (LOD) dataset about Italian cultural properties. ArCo KG is available at the MiBAC's official SPARQL endpoint[7]. The endpoint is based on the Open Source version of Virtuoso[8]. Besides the relevance of the produced resource, described in [5], ArCo pushes the state-of-the-art in knowledge graph engineering by sharing its "behind the scenes", i.e. the intellectual and methodological processes performed, the adopted design principles and the lessons learned, all of which constitute are well explained in [6].

The structure of the ArCo ontology is summarized by Fig. 3. The modular network aggregates sever coherent ontological modules that describe cultural objects from different perspectives. The modules `arco` and `core` define top-level concepts and global relations shared among all modules. The `catalogue` module is dedicated to catalogue records especially useful to preserve the provenance and dynamics of the data. The remaining 4 modules (cultural-event, denotative-description, location, context-description) focus on cultural properties and their features.

3.2 The HerMeS Ontology

The modules of the ArCo network support the description of cultural properties and thus constitute a good, ready-to-use, basis for the HerMeS ontology. However, ArCo mainly focuses on `movable` cultural objects and does not provide sufficiently detailed structures to capture the features of `immuvable` cultural properties and `intangible` cultural properties. Intangible cultural properties are in particular a central point of HerMeS to support cross-narratives linking different cultural aspects (e.g., archaeological, social, religious, rituals). HerMeS

[7] http://dati.beniculturali.it/sparql.
[8] https://github.com/openlink/virtuoso-opensource.

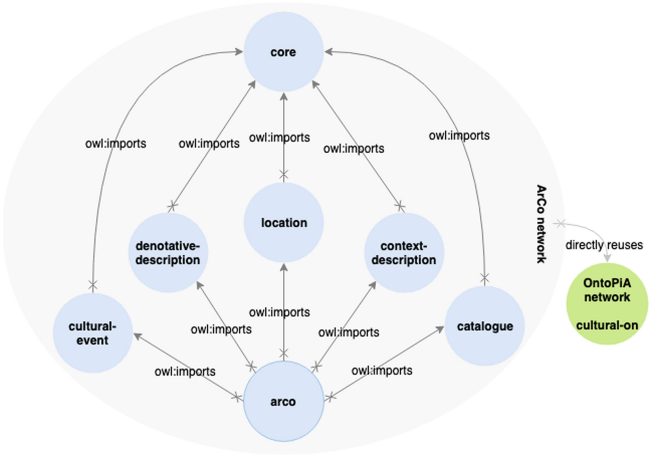

Fig. 3. Overview of the ArCo network of ontology modules from [5].

therefore extends ArCo by defining (and refining) concepts that support the needed level of expressivity. Figure 4 shows an excerpt of the HerMeS ontology pointing out some new concepts and their correlation with ArCo's structures.

HerMeS extends the concept `Immovable Cultural Property` by introducing the concepts `Unita Territoriale` and `Complesso Territoriale`. These concepts support a structured (and layered) description of a territory identifying parts (areas) and sub-parts that are relevant from an heritage perspective. In addition, HerMeS introduces a new type of `Immovable Cultural Property` called `Infrastructural Property` supporting the description of the topological structure of a territory. This concepts generally describe infrastructural entity that connect instances of `Complesso Territoriale` and may represent theirselves cultural properties. In addition to their infrastructural role, streets or square for example could be relevant from an heritage perspective also.

The main extension concerns the structuring of `Intangible` Cultural Property. HerMeS defines a detailed structure of transversal cultural and social properties that are correlated to the `Tangible` Cultural Property (either `movable` or `immovable`) defined into the knowledge. This is the central point correlating tangible with intangible entities that capture the culture, tradition, costumes of a certain territory.

Another central aspect of HerMeS is the capability of indexing modeled cultural properties according to different topics and point of view. With respect to the construction of contextualized narratives [13], the definition of a well-structured taxonomy of topics and themes supports the contextualisation, filtering, and retrieval of (sub-sets of) cultural properties that are relevant and coherent with respect to the selected topics. To define this contextualization, each `Cultural Property` is associated with a non-empty set of `Topic`. Topics are used to "tag" the description/content of a certain cultural entity as rele-

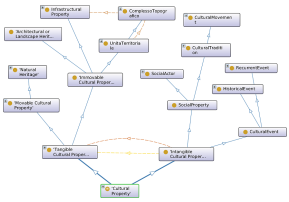

Fig. 4. Excerpt of the HerMeS ontology extending the notions of `CulturalProperty`.

vant with respect to the selected topics. The basic concept `Topic` was already defined in ArCo without a further/detailed specialization. Figure 5 shows an excerpt of the extension of this concept proposed within HerMeS. These topics are taxonomical structures defining perspectives (e.g., `religion`, `social`, `art`) that "classify" the type of content associated with the modeled cultural entities.

4 Generating Personalised Itineraries

4.1 HerMeS Point of View

HerMeS aims to promote the enhancement and enjoyment of Lazio's Cultural Heritage, in its many territorial manifestations and multiple meanings. Through a collaborative and participatory system, stakeholders become an active part of the system by sharing experiences, opinions, services, and tools [17].

There are two main considerations on which the design idea is based:

– **From institutional information to social experiences**: the amount of institutional, promotional and marketing information available and specially

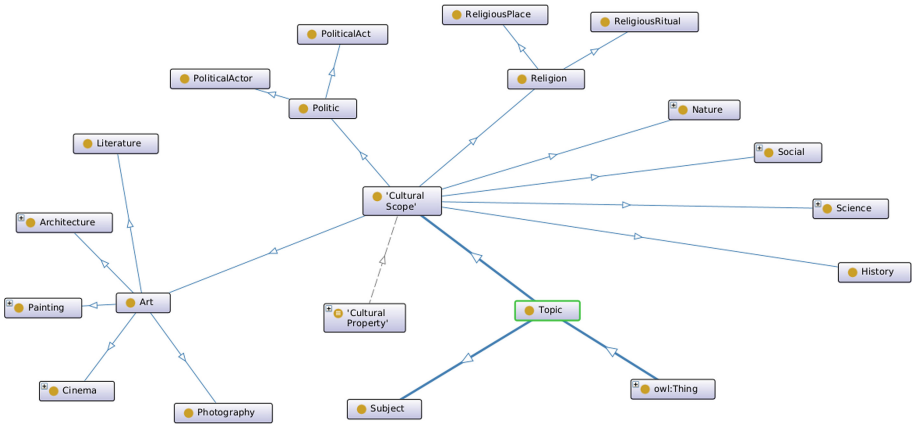

Fig. 5. Excerpt of the taxonomic structure characterizing semantic links between the modeled `CulturalProperty`.

prepared to provide valid support in choosing the places of cultural-tourist interest to visit is so large, it is often considered useless, misleading, and sometimes, even deceptive. On the other hand, we all know that in the moment of embarking on a trip or planning a visit, we rely more on the impressions (reviews, evaluations, stories, etc.) of other visitors and not on the "institutional" or "official" information that describes the place of interest. In other words, we not only trust the "experiences" of those who preceded us, but in many cases, we try to replicate them.
- **From data to information**: in a completely connected world, where information arrives from all over, the common expectation is to have a considerable amount of data precisely at the moment needed, both during the planning of a trip and during its course. Furthermore, this information must have a high "quality" and must be able to respond to particular needs and specific needs of users, linked, for example, to the presence of children, the disabled, etc.

From the first consideration comes the idea of creating a social platform in which content is generated, described and uploaded by the users themselves in the form of multimedia and multichannel *content*, called *PoI Point of Interest* thus proposing an innovative approach in the panorama of tools to support 'Cultural discovery'. On the other hand, for the proposed system to be able to provide valuable information, it must be intelligent. It must understand the expectations, and interests of users and, at the same time, take into account contextual situations (opening hours, availability of places, characteristics of the itinerary, presence of constraints or special needs). The APP must therefore be able to propose personalized paths in time and space. To this end, a study was conducted to evaluate the landscaping of the APP and other social platforms for touristic-cultural content sharing, as well as the current use of AI systems in cultural tourism promotion platforms and their impact in the reference context.

5 The Innovative Tool

The HerMeS project aims to provide a diverse range of tools and advanced services to enhance the enjoyment and exploration of Cultural Heritage, both tangible and intangible, within the Lazio region. These services are designed to cater to the needs of tourists, citizens, businesses, and public administration. HerMeS facilitates the connection of various heterogeneous needs and interests among different stakeholders. Through a bottom-up participation model and leveraging advanced IT technologies, including AI algorithms, personalised itineraries, and valuable information are proposed to tourists and visitors. Simultaneously, the project supports economic operators in defining strategies that align with interventions by the Public Administration. This collaboration fosters the development of sustainable and innovative solutions within the region.

Using AI and machine learning algorithms, the HerMeS APP analyses various variables such as user preferences, historical data, and current trends, to generate personalised itineraries for tourists. The APP recommends specific cultural sites, events or activities based on the individual's interests and preferences.

Furthermore, HerMeS offers real-time information and updates to economic operators, enabling them to make data-driven business decisions. The APP can provide insights on visitor traffic, popular attractions, and emerging trends, empowering operators to tailor their offerings and marketing strategies accordingly.

To support sustainable and innovative growth, the APP integrates a feedback system where users and operators can share their experiences, suggestions, and ideas. The Public Administration can leverage this feedback to identify areas of improvement develop innovative solutions, and prioritise interventions that enhance the cultural heritage landscape.

By combining advanced IT technologies such as AI algorithms, HerMeS can bridge the gap between diverse stakeholders and foster a participatory ecosystem focused on enriching cultural heritage experiences for tourists, citizens, economic operators, and the Public Administration.

6 The Envisaged User Interface

6.1 The Benchmarking Methodology

To achieve the project's objectives, an in-depth analysis and accurate comparison of numerous mobile applications dedicated to the enhancement of tangible and intangible cultural heritage was conducted, adopting the Benchmarking methodology. In project management Benchmarking *"is a process of investigation and learning from the best in a class to get useful information for improving and changing an organisation"* [1]. Its purpose is a kind of evaluation tool which is employed to compare and measure the subject of the project. This tool is essential to detect information or data to reach out for improvement [1]. Benchmarking methodology was applied to the comparative survey which examined the APPs available in the Google Play Store and Apple's App Store. The analysis was also extended to models for the description and representation of information about the resources to be enhanced. An extensive analysis was conducted on 17 platforms for the exploration and sharing of tourist-cultural content, identifying the main features and crossing them with the APPs that were able to support them. The result of this study is outlined in the diagram below:

	FUNCTIONALITY																
MOBILE APPS	Discover	Plan	Create content	Share with app's community	Connect with social platform	Suggested itineraries by geolocation	Audio guide	Feedback	Register itineraries	Share with social platform	Collect all routes as favourites	Share position	User profiling by AI	Download map	Buyticket guided tours	Reserve and buy the stay
Blincoo	✓		✓	✓												
Get Your Guide								✓							✓	
Google Maps				✓								✓		✓		
iDotto						✓	✓						✓			
izi.TRAVEL	✓	✓	✓			✓	✓				✓	✓				
Komoot	✓	✓		✓	✓	✓			✓	✓	✓	✓		✓		
Loquis			✓	✓			✓									
MapsMe		✓				✓					✓	✓		✓		
Minlnube	✓			✓												
MyWoWo	✓				✓		✓	✓		✓						
Roadrippers	✓	✓				✓				✓		✓				✓
Travello	✓		✓	✓	✓			✓		✓		✓				
Trip Case											✓					
Trip Advisor	✓			✓				✓							✓	
Steller	✓		✓	✓	✓											
Yamgu		✓				✓							✓		✓	
Zonzo Fox	✓	✓				✓	✓								✓	

Fig. 6. Survey of the main exploration and sharing of tourist-cultural content Apps

From the analysis of the results of the study, the most common features that arise are:

- *Territory exploration*: 10 out of 17 APPs support the user in the territory exploration phase. It is a must-have feature in tourism apps. For the traveller or the local user, it is useful for discovering hidden places, highlighting a place with details that are usually not noticed, and also creating personalised routes with out-of-the-box paths.
- *Sharing content*: proposing your own lived experiences to other users is the prerogative of the sharing functionality; this functionality is present within 8 out of the 17 APPs.
- *Audio Guide*: from a tool to support culture in museums, galleries, etc., it has made its way to become a function of tourist-cultural applications. In fact, in the study carried out, the number of apps identified with an audio guide is 5 out of 17.
- *Proposal of itineraries through geolocation*: the philosophy of geolocation is also in this case linked to the exploration of new routes and experiences. In this research, 7 out of 17 APPs contain this functionality.

Furthermore, the graph shown in (Fig. n° 7) highlights the lack of a tool to support the tourist who needs to receive information about a PoI around him or to discover or share new content and experiences. From the histogram, it is possible to ascertain that during the research of the state of the art of existing mobile apps, it emerged that there are applications that use artificial intelligence predictive modules but are nevertheless focused on a single functionality. For example, the creation of a new PoI does not take into account during the planning of an itinerary of possible constraints and parameters that instead can be allocated by the HerMeS application.

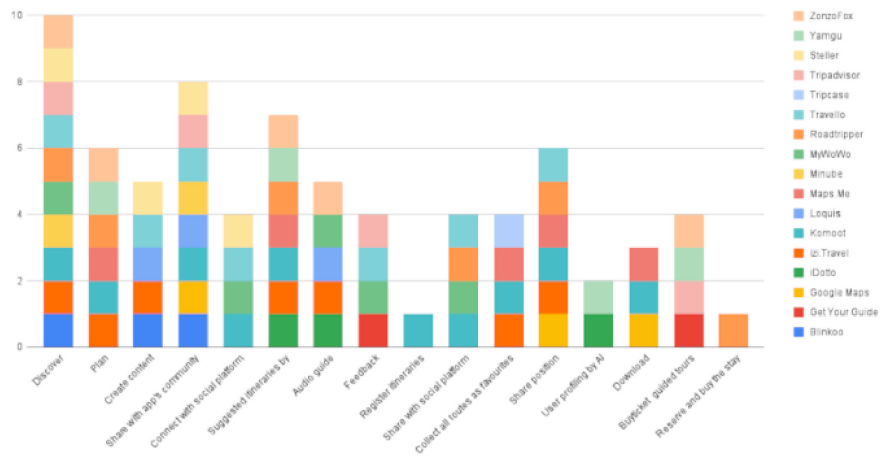

Fig. 7. Histogram representing main APP features

Based on the previous considerations and following User Centre Design [14], the User eXperience was designed focusing on the main features that emerged from the study conducted, such as:

- *Explore*: During the navigation phase, the user can set the reference position and radius in kilometres, enabling them to define their desired search area. A knowledge-based recommendation system comes into play at this point, classifying a subset of Points of Interest (PoI) as potential visiting opportunities based on the user's specified criteria. Factors such as the duration of the PoI visit, expected turnout, and preferred visiting times are taken into consideration by the recommendation system, generating paths that align with the user's indicated preferences and ensuring a tailored experience.
- *Tell*: a crucial step is a creative process that we called "TELL". It allows users to express themselves by creating multimedia and multichannel *content*. These contents give voice to the community's storytelling and provide a platform for people to share interesting content. This encourages interactions among users and fosters relationships based on evaluations of each other's experiences, as explained earlier in the first paragraph of the General Approach.

In the HerMeS application, users can tell their content through a sequence of Points of Interest that can enrich by adding pictures, movies, audio or text descriptions, etc. To ensure a smooth and user-friendly experience, the HerMeS APP was carefully designed with various navigation paths in mind. A collaborative prototyping tool called Figma was used to create an overall plan for the first two design levels. Therefore, *Telling*an experience with the HerMeS application can be done through the flow called *Point of Interest*. Here the user, while moving, can decide to add a new POI to her/his itinerary or to add a description of her/his travel experience, sharing it to the whole community. Concerning these macro functionalities, the various navigational paths were then studied to build the logical flow of the HerMeS concept in its 'activities'. To this end, a special rapid and collaborative prototyping tool was used, Figma[9], with which an overall scheme of the first two design levels were produced:

- *Navigation design*[10]: is about how the information is organized and which the navigational path can be followed by the users to reach a specific goal. For the HerMeS application, the team has set up a dry and intuitive setup to provide effective mobile navigation. It must help to give an impetus to the usability of the final product, avoiding the result of bad navigation that does not prepare the user to use the APP in its entirety as it was designed (Fig. n° 8).
- *Information design* [15]: it focuses on the structure of the application interface, which is important to visualize without taking into account the graphical aspect. Even if the graphical element is relevant to consider, this will be highlighted in a subsequent phase. An example is where to position the

[9] https://www.figma.com.
[10] https://m2.material.io/design/introductiontypes-of-navigation.

Fig. 8. App navigation design

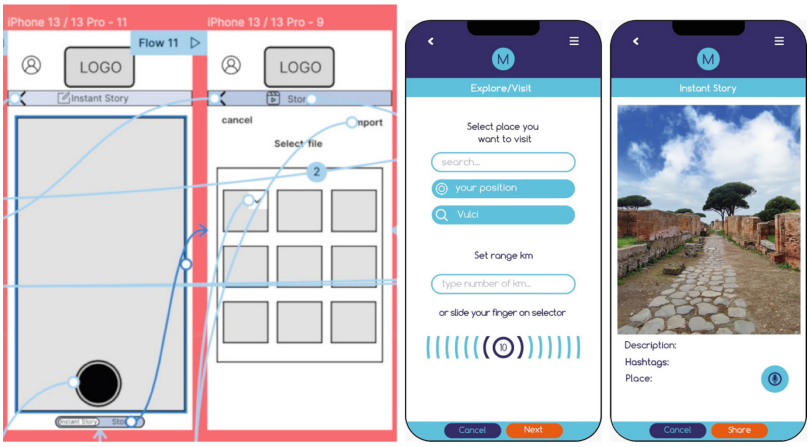

Fig. 9. Left: Information design from Figma and HerMeS APP mockup

button correctly to take a photo or record a video, or prepare a correct selection of content (photos or videos) for the creation of new content(Fig. n° fig:funzionespscrea).

Finally, after the possible graphic skin was produced, allowing the user generated a version of the APP with the graphic design of the HerMeS project (Fig. n° 9). The last step was the creation of a navigable mock-up that allowed us to test the navigational routes, ergonomics, and usability of the HerMeS APP (Fig. n° 10).

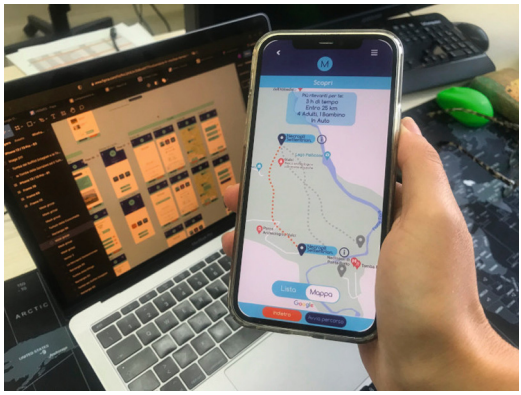

Fig. 10. HerMeS APP graphic skinning

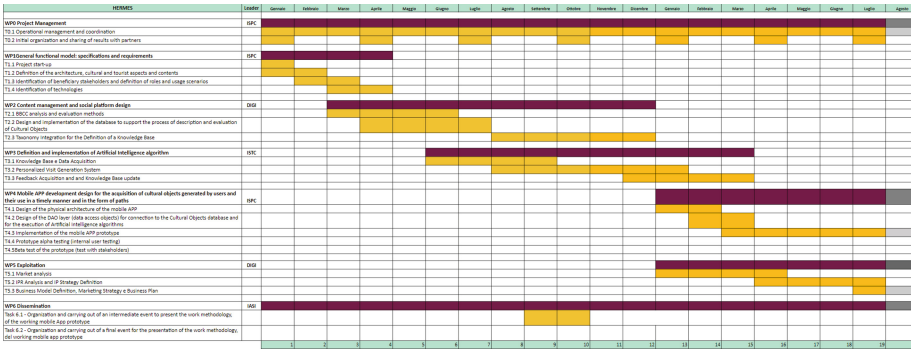

Fig. 11. GANTT Chart extract

7 Conclusion

In this paper, we have introduced HerMeS to the IT and Culture Heritage communities, presenting an innovative and captivating approach to promoting the Cultural Heritage of the Lazio region through advanced AI and ICT methodologies and technologies.

At the time of writing this paper, the mobile application is not currently available for download. The development landscaping is wide and in this paper's section, we illustrated the first steps regarding the user's request and we understood the navigation flow. Each step to follow is based on the Gantt chart [10] (Fig. n° 11) that has been edited to predict the execution phases project on its operating moments.

From the point of view of the software application (APP) industry, over the past decade, it has experienced a notable transformation in software development technologies. Companies of all sizes and across various sectors have shifted from native-platform programming languages to their modern, cross-platform

counterparts, often based on open-source technologies, to develop their suite of software products. In fact, the technologies we have used are Open Source. Based on the mock-up and the APP's architecture shown in the last paragraph, the technology that we choose to implement the front-end Hermes layer is the Flutter framework created by Google to create native frames for iOS, Android etc. About Back-end, the layer that handles the application's logic and process typically consists of servers, databases, and application servers that are responsible for managing the application's data and functionality. We choose Node.js (an open-source runtime system multiplatform event oriented to execute JavaScript code) and SQL (an open-source database).

However, adopting these youthful cross-platform technologies also entails certain considerations and trade-offs that require careful evaluation. This first phase of the design and development activities of the project provides an overview of the exciting progress achieved thus far. The potential impact of the HerMeS project is significant, not only for the Lazio region but also for the broader field of Cultural Heritage promotion and preservation.

Acknowledgement. The authors are partially supported by LazioInnova, Regione Lazio ("Gruppi di Ricerca 2020" - POR FESR LAZIO 2014, Ref. G04014).

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