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DIGITAL ROUTE PROPOSAL FOR CONNECTING COMMUNITIES WITH THEIR NATURAL AND CULTURAL HERITAGE: TiREASURE App

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Research Article

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Abstract

Access to heritage is often limited by economic, geographical, and temporal barriers, while challenges such as insufficient promotion and over-tourism threaten sustainability. The COVID-19 pandemic emphasised the need for remote access, increasing interest in digital heritage experiences. Heritage routes include natural and cultural elements, yet while principles for physical access are established, digital access regulations require development. Moreover, in current digital presentations of heritage, tangible aspects dominate, while intangible elements are insufficiently highlighted. The study aims to propose a digital platform that holistically represents both the tangible and intangible values of cultural routes by transferring relevant natural and cultural heritage assets into the digital environment. A historic town and its landscape on the Silk Road in far West Asia, Tire, Türkiye, is considered as the case study. Tire's heritage includes local herbs, rope-making crafts, and communal bathing traditions, all of which are threatened by urban migration and declining knowledge transmission. The methodology uses augmented reality (AR), interactive maps, 3D models, environmental sounds, and storytelling techniques to create immersive experiences that enhance accessibility. As a result, TiREASURE, a user-centered digital platform that integrates the tangible and intangible aspects of the natural and cultural route in Tire, provides a model for preservation planning. This study offers opportunities to experience natural and cultural routes remotely while also enhancing on-site experiences through digital tools. This approach helps mitigate issues of abandonment and over-tourism, promoting balanced, sustainable interaction with heritage. Additionally, it emphasizes the potential for interdisciplinary collaboration in creating innovative digital heritage solutions.

Keywords: Digital cultural routes, tangible and intangible heritage, Tire, immersive heritage experiences, soundscape

TOPLULUKLARIN DOĞAL VE KÜLTÜREL MİRASLARI İLE BAĞLANTILARI İÇİN BİR SAYISAL GÜZERGAH ÖNERİSİ: TiREASURE Uygulaması

Özet

Kültürel ve doğal mirasa erişim, çoğu zaman ekonomik, coğrafi ve zamansal engellerle sınırlanmakta; yetersiz tanıtım veya aşırı turizm gibi sorunlar ise sürdürülebilirliği tehdit etmektedir. COVID-19 pandemisi, uzaktan erişimin önemini vurgulamış ve dijital miras deneyimlerine olan ilgiyi artırmıştır. Doğal ve kültürel unsurları içeren miras rotaları için fiziksel erişim ilkeleri tanımlanmış olsa da, dijital erişim düzenlemelerinin geliştirilmesi gerekmektedir. Mevcut dijital miras sunumlarında somut nitelikler öne çıkarken, somut olmayan değerler yeterince vurgulanmamaktadır. Bu çalışma, ilgili doğal ve kültürel miras varlıklarını dijital ortama aktararak kültürel rotanın somut ve somut olmayan boyutlarının bütüncül biçimde temsil edildiği bir platform sunmayı amaçlamaktadır. Türkiye'nin Batı Asya'da, İpek Yolu üzerindeki tarihi bir kenti olan İzmir-Tire, vaka çalışması olarak seçilmiştir. Tire'nin mirası; yerel otlar, urgan yapımı zanaatı ve hamam geleneği gibi unsurları içermekte olup, büyük kentlere göç ve bilgi aktarımındaki azalma nedeniyle tehdit altındadır. Yöntem olarak artırılmış gerçeklik (AR), interaktif haritalar, 3D modeller, çevresel sesler ve hikâye anlatımı teknikleri kullanılarak erişilebilirliği artıran sürükleyici deneyimler tasarlanmıştır. Sonuçta geliştirilen kullanıcı merkezli dijital platform TiREASURE, Tire'nin doğal ve kültürel rotalarını somut ve somut olmayan boyutlarıyla bütünleştirerek koruma planlaması için bir model sunmaktadır. Bu yaklaşım, kültürel rotaları dijital ortamda deneyimleme fırsatı sunarken yerinde deneyimleri de desteklemekte; terk edilme ve aşırı turizm sorunlarını azaltarak mirasla dengeli ve sürdürülebilir bir etkileşimi teşvik etmektedir. Ayrıca yenilikçi dijital miras çözümlerinde disiplinler arası iş birliğinin potansiyelini vurgulamaktadır.

Anahtar Kelimeler: Dijital kültür rotaları, somut ve soyut miras, Tire, sürükleyici miras deneyimleri, ses peyzajı

1. INTRODUCTION

Cultural routes, as defined by the ICOMOS Charter (2008), provide a structured approach to connecting diverse heritage elements and play a key role in fostering cultural exchange and sustainability. The Charter highlights values such as identity, integrity, and authenticity, and outlines methodologies for their development and preservation of them. Achieving these goals often involves global initiatives that integrate digital tools with heritage preservation (UNESCO, 2003). Promoting heritage also poses challenges. Insufficient promotion can lead to a lack of visitor interest, resulting in threats such as abandonment, neglect, and eventual disappearance. Conversely, excessive promotion, particularly through modern tools such as social media, can lead to overtourism (Alonso-Almeida et al., 2019). Over-tourism can result in pollution, vandalism, and superficial visitor engagement that overlooks deeper historical and cultural significance. Addressing these issues requires balanced solutions that protect heritage while making it accessible through innovative and sustainable means.

1.1. Previous Studies on Digitalisation of Cultural Heritage

Physical access to heritage sites remains restricted by economic constraints, time limitations, and geographical distance. Additionally, the COVID-19 pandemic has heightened demand for remote access, as travel restrictions have driven greater interest in digital experiences (Ren & Chen, 2021). A considerable amount of research has been conducted from various perspectives in this field. For example, Halaç and Öğülmüş (2021) discussed a system providing open access to three-dimensional models of cultural heritage structures, while Zaibon et al. (2015) focused on the system requirements for digital cultural heritage experiences and the improvement of user interactions. Yelmi (2016) examined the concept of soundscape as intangible heritage, analysing ambient soundscapes by categorising them and presenting the recordings on a website. Similarly, Sönmez and Doğu (2021) presented a project in which ambient soundscapes were generated through a mobile application accompanied by storytelling. Furthermore, Nacak (2020) offered a perspective on the transfer of cultural heritage to future generations by exploring the combination of storytelling and digital technology. Varinlioğlu et al. (2019) investigated the creation of an interactive learning environment by modelling an archaeological site within the framework of a "serious game." Iakovaki et al. (2023) analysed various projects that have contributed to the digitalisation of cultural heritage and conducted surveys to assess public preferences for digital approaches in route creation. Additionally, Emmanouilidis et al. (2013) identified the software and hardware requirements necessary for implementing a digital route.

There are also international initiatives to digitise cultural heritage. European Commission initiatives, such as the HORIZON program, emphasise digitising heritage assets to ensure accessibility and long-term preservation (European Commission, 2023). These programs promote interdisciplinary collaboration and the use of 3D modelling, AR, and VR for immersive experiences. A major initiative, the Cultural Heritage Cloud, was developed under Horizon Europe's 2021-2022 Cluster 2, "Culture, Creativity & Inclusive Society." Cultural and creative industries (CCIs) are vital for preserving heritage but face obstacles, including limited funding, climate change, and slow international cooperation (European Commission, 2021). The project aims to restore and promote heritage in less-popular areas using digital tools, while also fostering cultural ties and a sense of belonging. Its three core themes are green, innovative, and digital cultural heritage, addressing climate impacts, asset trafficking, support for small markets, and the digital transformation of public libraries. The digital cultural heritage theme within the scope of this research encompasses 14 projects that use technological innovations to protect and promote cultural heritage globally. These initiatives focus on protecting cultural heritage, preserving traditional craftsmanship, and enhancing the resilience of cultural and creative industries (CCIs), increasing transparency in the music ecosystem, improving accessibility to cultural experiences, and modernising the performing arts sector. They range from developing digital tools to combat illegal activities to preserving artefacts and creating immersive video games that foster empathy and understanding in museums, addressing memorialisation and transitional justice. However, these projects typically do not incorporate natural or cultural heritage routes, except for the CULTURATI project (CULTURATI, n.d.), which includes a route concept (Table 1).

Table 1. Digital cultural heritage projects in Horizon Europe (Prepared by the authors).

Name of the project	Cultural Heritage Type	Is it a route?
AURORA	cultural heritage artefacts (protection from illegal activities)	No
CRAEFT	traditional crafts	No

Table 1. Digital cultural heritage projects in Horizon Europe (continued).

PERCEIVE	preservation of colored cultural heritage collections	No
CULTURATI	site-based CCIs (such as museums, art galleries, theatres)	Yes
MUSIC360	local music	No
FAIR MUSE	music ecosystem in Europe	No
OPENMUSE	music ecosystem in Europe	No
MEMENTOES	video games for museums	No
MEMORISE	heritage related to Nazi Persecution (historical narratives and photographs)	No
REPERTORIUM	medieval and classical European art-music works	No
PREMIERE	performing arts, focus on dance and theater	No
SCENE	film production for the promotion of the European cultural heritage	No
SHIFT	technological tools for people with disabilities.	No
MUSEIT	technological tools for people with disabilities.	No

1.2. Digitalisation Level of Current Cultural Routes

To assess the impact of digital tools on accessibility and engagement, ten cultural routes were reviewed: six from the Council of Europe (Council of Europe, 2024) and four from the Culture Routes Society of Türkiye (Culture Routes Society, 2025) (Table 2). All routes had websites, most had social media, and a few offered mobile apps. The Saint James Way, Via Eurasia, and Sultan's Trail were available on all three platforms. Websites, social media, and apps each serve distinct user needs such as information, updates, and in-field navigation. All routes used visual elements, with some offering layered maps or virtual tours featuring 3D modelling and 360-degree photos. Auditory features were present in most routes, including storytelling and ambient soundscapes. Several routes combined visual and audio resources for an immersive experience, and some included videos or even interactive games. Sensory experiences such as smell, taste, and touch were represented through visuals and audio, including images of steam or the sound of wind. Half of the routes used both visual and auditory means to convey these senses, while one relied solely on audio (Table 2).

Table 2. Digital presentation type (Prepared by the authors).

	Digital Platform			**Digital Tools**									
				Direct Senses								**Indirect Senses (smell, taste, touch stimulate)**	
				Visual			**Audial**		**Visual+Audial**				
Routes	**Website**	**Social Media**	**Mobile Application**	**Photo, Text and Map**	**Map with numerous filters**	**Virtual tour**	**Storytelling (historical or fictional story)**	**Ambient sounds (keynote, signal, soundmark)**	**Virtual tour with audio**	**Serious games**	**Videos**	**Visual (with picture or video)**	**Auditory (with sound or narration)**
The Saint James Way													
Via Eurasia													
Route of Industrial Heritage													
Roman Emperors and Danube Wine Route													
Via Regia													

Table 2. Digital presentation type (continued).

Route of Historic Thermal Towns													
European Route of Ceramics													
Sultans Trail													
Tolerance Way													
Ephesus Mimas Route													

1.3. Significance and Objectives of the Research

Despite the significant potential of emerging technologies to enrich digital heritage experiences, their comprehensive application within cultural routes remains limited. Existing platforms typically priorities single-structure modelling or provide only basic sensory functions, often lacking essential interactive or participatory features. Consequently, integrated approaches capable of encompassing both tangible and intangible heritage within cultural routes remain insufficiently developed. To address this gap, this study aims to design a user-centered digital platform that holistically represents the assets of a cultural route by integrating natural and cultural heritage elements into an interactive digital environment. The platform aims to:

- Expand access to heritage through remote and on-site digital tools.
- Address abandonment and over-tourism by providing balanced, sustainable presentation methods.
- Strengthen the connection between individuals and heritage through immersive and interactive experiences.
- Using storytelling, environmental sounds, and digital reconstructions, the proposed platform will offer visitors an engaging, customizable route experience, fostering a deeper understanding of cultural and natural heritage.

To effectively develop and contextualise the proposed digital platform, it was crucial to select a study area rich in multi-layered heritage. Tire, a district in İzmir, Türkiye, was deemed the ideal location due to its historically strategic position along trade routes, including the Silk Road. This unique setting has endowed the region with a wealth of tangible heritage elements, such as khans and bazaars, as well as a vibrant intangible cultural heritage sustained by traditional handicraft production practices. Furthermore, its longstanding designation as "Green Tire" highlights its natural significance. However, Tire faces risks such as urban migration from rural to urban areas (Metlioğlu, 2020), which threatens the loss of its traditional lifestyle and architectural fabric, while potential over-tourism, driven by exposure through popular media platforms, risks overwhelming its resources and compromising its authenticity. While forest expansion is a positive development, urbanisation threatens the natural environment (Tan, 2023). Agricultural mechanisation and industrialisation have largely replaced traditional practices, while a declining young population endangers traditional sectors such as agriculture and crafts.

The craft of rope making exemplifies these issues. The fact that only one person in Tire continues this craft highlights the failure to preserve the master-apprentice relationship into the present day. Similarly, the lack of maintenance and promotion of the region's cultural heritage has led to the neglect of Tire's historical and natural assets. The inadequate enforcement of conservation zoning plans heightens risks to both historical and natural environments. The city contains numerous monumental and civil structures, including baths, that are in urgent need of restoration. Changes in modern bathing habits have made these baths unused, and their potential as tourist attractions remains redundant due to insufficient promotion.

These challenges highlight the urgency of developing innovative, sustainable approaches to heritage preservation and presentation, underscoring the serious threat posed by the lack of a holistic approach that respects the region's historical and natural environment. Effective implementation of conservation plans, support for traditional production methods, and the use of modern technology to promote off-site and on-site cultural route experiences can help revitalise Tire's natural and cultural heritage.

The scope of this research encompasses the conceptual design and user interface development of the proposed digital cultural route for Tire. The study excludes full software implementation, which necessitates interdisciplinary collaboration; instead, it prioritises the digital representation of tangible and intangible heritage. To support this design proposal and verify its feasibility, a dedicated social media presence was also established.

2. METHODOLOGY

In alignment with the scope and objectives outlined in the previous section, this study employed a comprehensive methodology comprising three main stages: a literature review, fieldwork, and data analysis. These phases formed the basis for the subsequent development of a digital platform prototype and a comparative evaluation (Figure 1).

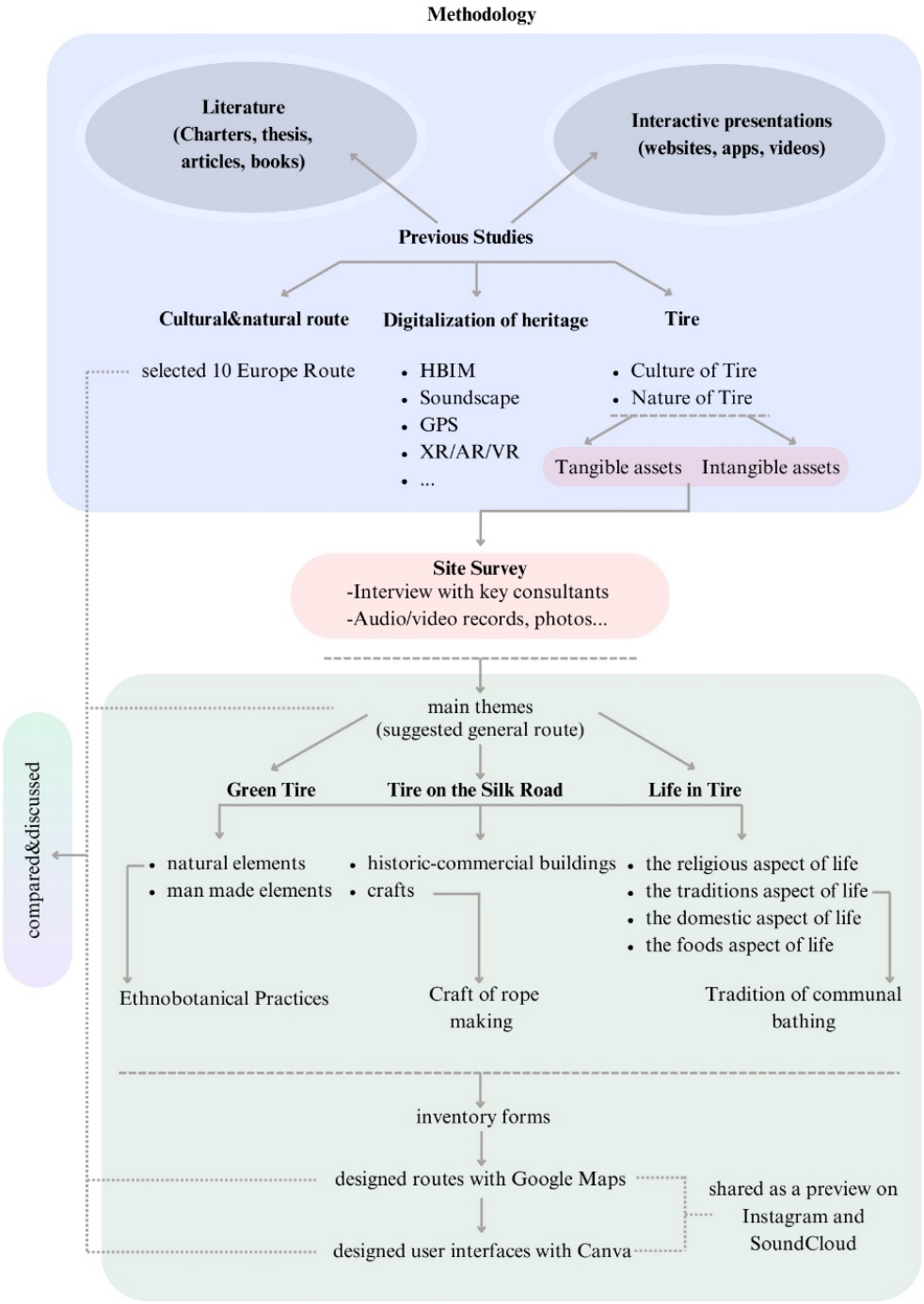

Figure 1. Methodology (Prepared by the authors).

The study began with a comprehensive review of cultural route research, examining written sources (charters, theses, articles, books, journals) and digital materials (websites, applications, videos, audio recordings). Ten cultural and natural routes from Europe and Türkiye were analysed based on digital visibility. Additionally, the digitisation and presentation of cultural heritage were explored. Findings revealed a focus on singular aspects, lacking an integrated, interactive approach, suggesting a user-centric platform for holistic presentation of the cultural route.

Fieldwork in Tire included multimedia documentation and semi-structured interviews with local craftspeople and community representatives. Surveys with residents (40–75) provided insights into cultural assets, tourism, and environmental sounds. Among the ten analysed cultural routes, five were historical and five themed, all featuring natural assets. Similarly, Tire's tangible and intangible heritage was explored, with themes selected to highlight its natural features, the human-nature connection, endangered crafts, and immersive local experiences.

The main themes that represent Tire's heritage are:

• Green Tire – Natural assets.

• Tire on the Silk Road – Historical commercial significance.

• Life in Tire – The intersection of past and present daily life.

Based on key assets identified through interviews, cultural routes were initially mapped on Google Maps and organised under specific subthemes: "Ethnobotanic practices" (Green Tire), "Craft of rope making" (Tire on the Silk Road), and "Tradition of communal bathing" (Life in Tire). These subthemes were assessed using inventory forms to evaluate their historical and current status, authenticity, and integrity (Tables 3-5). Following this assessment, the development process began with creating the route infrastructure in Google Maps, accompanied by ambient soundscapes from SoundCloud. These elements served as the basis for the conceptual user interface of the TiREASURE platform, which was designed in Canva (Gülkaya, 2025a). The Canva prototype visualised by integrating map screenshots and detailing proposed functionalities, such as user-generated content, AR-based historical visualisations, digital stamps, and gamification. However, since full software implementation was outside the scope of this study, an Instagram account was subsequently established to simulate the user experience and disseminate content (Gülkaya, 2025b). AI-generated videos (via OpenAI ChatGPT-4) simulating AR experiences, such as the rope-making loom, were published on this platform. All digital assets were gathered on a Linktree page, and the link was added to the Instagram profile header (bio).

Table 3. Characterisation of tradition of communal bathing (Prepared by the authors).

Name of cultural heritage		**Tradition of Communal Bathing**	
Related Tangible Characteristics	**Locations**	https://www.google.com/maps/d/u/0/edit?mid=1m2tNgJk2-CfCuFruVJj0tgd0bSmxTck&usp=sharing	
	Spatial Characteristics	three categories based on their hot room plans: 1. Cross plan with corner cells and four iwans 2. Rectangular plan with a dome and double private rooms 3. Equal-sized warm room, hot room, and private room.	
	Material Used	rubble stone, cut stone, brick, spolia	
		Historical	**Current**
	Existence and State	Built between the 14th and 17th centuries (Çakmak 2002)	7 / 20: not existing (Çakmak 2002) 3 / 20: almost good conservation state 10 / 20: poor conservation state
	Indispensable Resource	"The two hundred and seventy fountains of the city flow their water like the *Kevser* water coming from the Balpınarı and Şekerpınarı plateaus. (...) In this city, waterways flow from house to house, starting from the foothills of the Kestaneli Mountains (Güme Mountains)" (Kurşaklıoğlu 2016)	Water from the Municipality's water system
	Tool Used	Metal bowl, clog, loincloth, barber washbowl, ewer, caldron, and wood (for heating water in the furnace)	**Until 2020 (up to the onset of pandemia)** Plastic or metal bowl, plastic slippers or clogs.
			After 2020 No tools are currently being used because the baths are closed.
	Users	People of Tire. Hafsa Hatun, Yeniceköy, Molla Arap, Şeyh, and Tahtakale baths, which are single baths, separate days are determined for men and women	**Until 2020 (up to the onset of pandemia)** People of Tire and rarely tourists
			After 2020 It is not used by anyone and has been abandoned.

Table 3. Characterisation of tradition of communal bathing (continued).

		Historical	Current
Related Intangible Characteristics	**Process**	Getting ready in the disrobing room and changing clothes. Pouring water from the basins into a metal bowl, entertainment activities, and sometimes felt production in the hot portion. If there was a heated marble slab (*göbek taşı)*, one would be rubbed with a coarse bath-glove (*kese*). Resting, drinking coffee, and dressing in the cold room.	**Until 2020 (up to the onset of pandemia)** In daily use, people do their individual cleaning and leave the bath.
			After 2020 It is not used by anyone and has been abandoned.
	Sociocultural Qualities	-Bridal bath organisation for women before the wedding -Coffee stove niche in the disrobing room of Yalınayak Bath. -Felting room in Tahtakale Bath. -The bath known as Yalınayak Bath was also referred to as "Sin Bath". The name comes from the fact that the pool, known as a mikvah, was used by both Jewish men and women. However, it is believed that men and women use the pool at different times, alternating between them (Çakmak 2019).	**Until 2020 (up to the onset of pandemia)** -Eski-Yeni Bath and the Yalınayak Bath were used as bath -Sultan Bath was used as a painting studio and later as a printing press, but it is abandoned today. ---Tahtakale Bath was used as a handicraft exhibition and bazaar, with weaving looms inside, but it is abandoned today. -The others lack sociocultural qualities due to abandonment.
			After 2020 -Eski-Yeni Bath and the Yalınayak Bath were closed when the pandemic started.
	Audial Qualities		
	Sound Type	Religion☐ Nature☐ Entertainment & Leisure☐ Festivals & Events☒ Urban☐ Street Vendors☐ Sports☐ Transportation☐ Food & Drink☐ Craft☐ Health☒	
	Sound Definition	Keynote☒ Signal☒ Soundmark☐	
		Historical	**Current**
	Frequency of Sounds	Daily☒ Weekly☐ Seasonal☐ Annual☐	Daily☐ Weekly☐ Seasonal☐ Annual☐
	Details (day, time...)	Since there were no separate sections for men and women in single baths, women used them on certain days of the week, while men used them on others. Accordingly, human voices also differed.	**Until 2020** 18/20: Traditional sounds lost 2/20: Traditional sounds sustained
			Since 2020 (pandemic era) 20/20: Lost
	Stages of Sounds	Continuity of the sound of running water in the disrobing area of some baths The sound of water filling the basins in the hot rooms. The sound a metal bowl makes when placed on marble The sound of clogs while walking The sound of scissors in the shaving room The sound of wood burning in the furnace The sound of felt beating in the baths with a felting room	**Until 2020 (beginning of pandemic)** Continuity of the sound of running water in the disrobing area of some baths The sound of water filling the basins in the hot rooms. The sound of slippers while walking
			After 2020 Traditional sounds lost
Documentation		Photos ☒ Video record ☒ Sound record ☒	

Table 4. Authenticity of qualities (tradition of communal bathing) (Prepared by the authors).

AUTHENTICITY	+2	+1	0
Form and Design	Traditional spatial organisation and architectural elements were preserved in all cases. ☐	Traditional spatial organisation and architectural elements were preserved in a limited amount; almost half were renewed, and some were lost. ☒	Original spatial organisation was lost to a great extent in all cases. ☐
Construction Technique and Material	Original materials preserved/ compatible materials used in the restoration in all of the examples. ☐	Authentic construction techniques and materials were preserved totally in limited examples, in almost half of the examples, and lost in some cases. ☒	Original materials have been completely lost / incompatible materials have been used in all of the examples. ☐
Function and traditions, spirit	Original function sustained in all of the examples. The residents' usage frequency sustained. The spirit of place (sounds and scents) sustained. ☐	Original function sustained in a limited example. The limited usage of the residents. The spirit of place (sounds and scents) sustained. New functions attributed to place, renewal of processes and tools in limited examples, most have been abandoned. The spirit of the place has changed. ☐	New function attributed to place, renewal of processes and tools, or abandonment of all the examples. The locals rarely use the place. The spirit of the place has changed. ☒

6-5 Point: Authentic ☐ 4-3 Point: Less authentic ☐ 2-0 Point: Not authentic ☒

Table 5. Integrity of qualities (tradition of communal bathing) (Prepared by the authors).

INTEGRITY	+2	+1	0
Elements	Includes all physical elements of the traditional environment for all the related buildings/spaces/elements, the related activity in the vicinity sustained for all related buildings/spaces/ elements. ☐	Includes all physical elements of the traditional environment for all, only a few of the related buildings/spaces/elements, but the related activity sustained in the vicinity of many of the related buildings, spaces, and elements. ☒	Includes none of the physical elements of the traditional environment, the related buildings/spaces/elements, and the related activity not sustained in the vicinity of the related building, spaces, or elements. ☐
Size	The related buildings/spaces in the traditional environment are of adequate size for all cases. ☐	The related buildings/spaces in the traditional environment are of adequate size in a few examples, limited in size in almost half of the examples, and very small in some/half of cases. ☒	The related buildings/spaces are not of the traditional size; they are very small in all cases. ☐
Management	Well-managed environment for all cases. ☐	Well-managed environment for a few examples, partially managed for almost half, and unmanaged for a few. ☒	Unmanaged environment: no measures undertaken, no urban interventions for all cases. ☐

6-4 Point: Integrated ☐ 3-2 Point: Less integrated ☒ 1-0 Point: Not integrated ☐

In the final stage, the study analysed Tire's heritage values and compared the proposed digital route experience with existing cultural routes in Europe and Türkiye, ultimately re-evaluating the ICOMOS Charter on Cultural Routes (2008) to suggest updates reflecting advancements in digital heritage practices.

3. FINDINGS

Building on the data collection and classification procedures outlined in the Methodology, this section presents the findings regarding Tire's traditional practices. The analysis focuses specifically on ethnobotanical practices, rope making, and bathing traditions. These cultural insights serve as the foundational framework for the digital application interface, the design details of which are presented later in this section.

3.1. Natural and Cultural Assets of Tire

Tire is a district in southeastern İzmir, bordered by the Küçük Menderes Plain to the north and the Aydın Mountains to the south (Figure 2). Known as "Green Tire," the region features the fertile Güme Mountains. This rich land has hosted numerous civilisations throughout history, including the Hittites, Lydians, Persians, and Ottomans. Tire has also been a multicultural settlement, where Christians, Jews, and Muslims lived together over the centuries (Tire Municipality, n.d.).

Figure 2. Location of Tire (OpenStreetMap, n.d.).

Tire emerged as a key trade center between the 14th and 16th centuries due to its strategic location on routes connecting Anatolia to western ports. In addition to agricultural goods, textiles and ropes were transported to İzmir and İstanbul for export (Yüksel, 2015), leading to the construction of inns and covered markets that still exist today. The Tire Market, the largest open-air market in contemporary Anatolia (Türkyılmaz, 2011; Tan, 2023). Tire is also noted for its local cuisine, historical architecture, and vibrant cultural traditions.

3.1.1. Tire's biodiversity, traditional herb gathering, and market culture

The southern mountainous region of Tire is a significant biodiversity area located between the İzmir Bozdağlar and Denizli Babadağ Important Plant Areas (Seçmen et al., 2015). The region hosts 205 genera and 264 plant species from 70 families, including seven endemics (Tan, 2023). Herb gathering in Tire is a communal practice, primarily among women in small groups, aiding seed dispersal and regrowth. Various plant parts, roots, stems, fruits, seeds, leaves, and flowers, are collected for food, medicine, and handicrafts (Şahin, 2019; Yıldırımlı, 2004). Ethnobotany examines how local communities utilise these plants for food, medicine, and handicrafts (Yıldırımlı, 2004), with edible herbs being boiled, roasted, or dried, while medicinal plants serve both human and animal health. Fibrous plants have historically been used for weaving and crafting items such as brooms and baskets (Şahin, 2019).

Tire's marketplace, dating back to 500–300 BC under Persian, Lydian, and Macedonian influence (Meriç, 1983; Muslu, 2005; Yüksel, 2009), flourished through the Roman, Byzantine, and Ottoman periods (Texier, 2002). Today, the market opens at sunrise with prayers, showcasing a tradition of commerce and community, highlighting Tire's sustainable use of plant diversity and cultural integration.

3.1.2. Hemp as a material and the rope-making process

Historically, hemp was vital for rope making in Tire due to its durability and local abundance along the Küçük Menderes River. However, changing market conditions after 1980 led to the end of hemp cultivation in the region (Gülersoy & Çelik, 2014). Today, raw materials are sourced from outside Tire, according to local rope maker Raife Baysal.

Rope making was a communal activity in neighborhoods, streets, and gardens (Tokluoğlu, 1973). The process involved harvesting hemp, soaking it for a week, drying, beating, threshing, combing, and spinning the fibres using a wheel in open spaces. At the Urgancılar Bazaar, rope quality was strictly regulated, with substandard products destroyed and offenders fined (Gürçay, 1968). Tire ropes held historical significance, even used in the conquest of Istanbul by Mehmet the Conqueror. Today, the craft has shifted from functional production to cultural preservation, with ropes made as souvenirs and demonstrated in museum settings (Figure 3), reflecting the evolving role of heritage crafts.

Figure 3. Rope in Tire Museum, (Authors' archive).

3.1.3. Historical and current state of baths

Baths in the region were primarily constructed between the 14th and 17th centuries, reflecting the architectural and social traditions of their time (Çakmak, 2002). Historically, these structures were integral to social life, serving not only as places for cleanliness but also for communal gatherings and cultural rituals. However, their current state reveals a stark contrast. Of the 20 documented baths, 7 do not exist, 10 are in poor condition, and only 3 are well-preserved. The sociocultural significance of these baths was deeply embedded in their design and use. For instance, Yalınayak Bath, featured unique elements such as a pool for Jewish rituals (*mikvah*) and niches for social coffee gatherings (Çakmak, 2019). Tahtakale Bath included a felting room, reflecting its multifunctionality. Historically, bath usage was communal, beginning in the disrobing area (*soğukluk)* before transitioning to the hot section (*sıcaklık)* where guests would pour water from metal bowls and use coarse bath gloves (*kese*) for exfoliation. Traditional bridal bath ceremonies also held cultural significance. Today, most baths are abandoned, with only a few, like Tahtakale Bath, have been repurposed for exhibitions. Eski-Yeni and Yalınayak Baths operated before the pandemic but have since closed, further endangering bath culture (Figure 4).

Figure 4. Eski-Yeni Bath and Yalınayak Bath (Authors' archive).

3.2. TiREASURE App

The proposed system focuses on making cultural heritage universally accessible, enabling users to engage with both tangible and intangible aspects of Tire's heritage, either on-site or remotely. It requires an internet connection via Wi-Fi or a cellular network, GPS, a camera, and a microphone for full functionality. The application is available through both the App Store for iOS devices and the Play Store for Android. Optional VR glasses are also supported to further enrich the user experience.

The initiative begins with a thematic exploration of Tire, offering three distinct routes: Green Tire, Tire on the Silk Road, and Life in Tire. Each route offers a unique lens on the region's historical, natural, and cultural richness (Figure 5). The system offers visitors the option to take a quick tour based on a suggested route developed from popular interview responses, or to delve deeper into a chosen sub-theme for a more immersive experience.

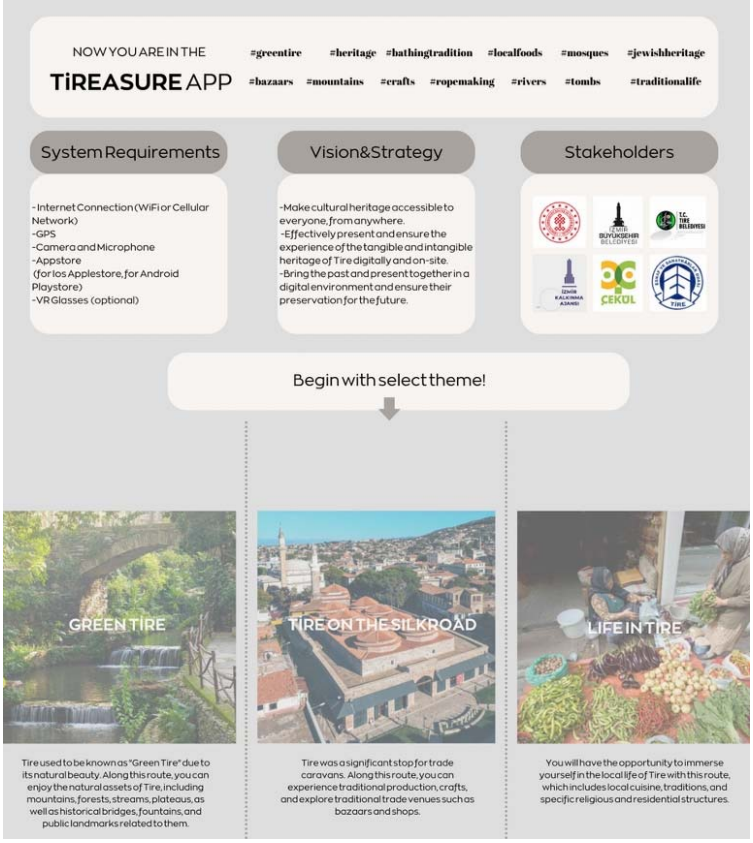

Figure 5. Opening page and main themes of the TiREASURE App, (Prepared by the authors).

3.2.1. Green Tire

Green Tire highlights the area's natural beauty. Among the thematic options are two sub-themes: 1. natural places such as ethnobotanical plant areas, forests, monumental trees, streams, and plateaus; 2. man-made structures such as fountains and bridges. In this study, “ethnobotanical plant areas: benefiting from self-seeding plants” has been selected as the primary focus. Visitors can explore the journey of plants from nature to market. The selected route includes Güme Mountain and its surroundings, where endemic plant species thrive. Visitors may choose between a nature walk through plant-growing regions or a market tour showcasing the sale of these plants. Additionally, a proposed route featuring villages with endemic plant varieties can be customized by adding or removing stops. Both on-site and remote experiences are offered. On-site experiences require users to enable internet, location settings, and camera access for augmented reality (AR) interactions, while remote experiences require internet and audio settings.

Soundscape features enhance the experience through three sound categories (Schafer, 1977; Yelmi, 2016): keynote (background ambiance, like a flowing stream), signal (consciously recognized sounds, such as a bird's call), and soundmark (unique regional sounds, such as a prayer at the market). Visitors can also hear narrated stories, such as "The Journey of Plants from Nature to Market," and use a map-based feature to pin plant photographs they capture, contributing to a shared knowledge base.

AR experiences are activated at key points along the route. For instance, users can visualise the covered bazaar (*Bedesten*) with sights and sounds by activating their cameras. Pointing to a dried-up stream can simulate flowing water, and a woman with a donkey crossing the bridge can deepen the narrative. Remote experiences are enhanced with storytelling about the environment, including scents, seasonal temperatures, and the flavour of edible plants for a multisensory experience.

The application provides a dynamic interface for further exploration, including 3D tours, videos, and historical photographs. Users can learn about plant-gathering tools, hear the sounds of fountains, and view market stories through visual and auditory media (Figure 6). A fun quiz at the end reinforces learning, with questions presented in

visual or auditory formats, such as identifying plants by their images or recognizing a vendor's voice and guessing their wares.

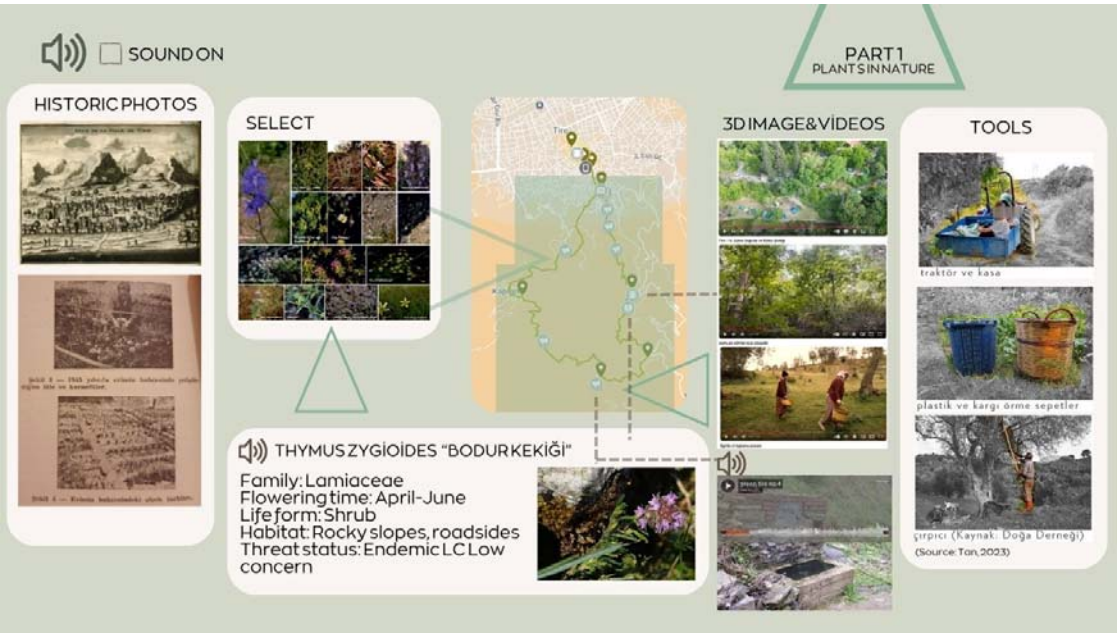

Figure 6. Remote experience page in ethnobotanical plant areas, (Prepared by the authors).

Finally, the platform invites visitor feedback, allowing users to share their experiences based on themes such as the natural environment, marketplace, management, or general suggestions. Visitors can also upload photographs taken at designated "historic pinpoints for photos," contributing to a time-lapse archive. Visitors receive digital stamps for route passports, fostering a sense of accomplishment and continued engagement.

3.2.2. Tire on the Silk Road

The system offers visitors the suggested route or delves deeper into a chosen sub-theme for a more immersive experience. Among the thematic options, one focuses on historic commercial buildings, including khans and the *Bedesten*, while another highlights traditional crafts such as rope-making, weaving, clog-making, wickerwork, felting, saddlery, pack-saddle production, and quilting traditions. In this study, "the craft of rope making" has been selected as the primary focus. Visitors can choose to explore areas around the Küçük Menderes River, historically known as the raw-material supply area, or visit sites where rope production and sales traditionally occurred. The proposed route can be customised by selecting historical or contemporary elements, allowing visitors to create their experience. Both on-site and remote access options are provided, ensuring accessibility for all.

As with other themes, the soundscapes enhance sensory engagement. Keynote sounds, such as the rhythmic turning of the rope-spinning wheel, form the auditory backdrop. Visitors can also listen to the narration titled "The Story of Rope Making," which provides historical and cultural insights into this craft. For an augmented reality (AR) experience, activating the camera at specific locations, such as the courtyard of a traditional house, reveals a virtual recreation of an old spinning wheel in operation, demonstrating the traditional methods of rope production (Figure 7).

Remote experiences are enhanced, featuring drone footage of areas that once hosted hemp fields, instructional videos on rope-making techniques, interviews with artisans, and sensory storytelling that describes the texture and smell of ropes. Informational panels introduce the tools used in rope making, while a street-view exploration of the historic rope-makers' bazaar is supplemented with historical photographs (Figure 8).

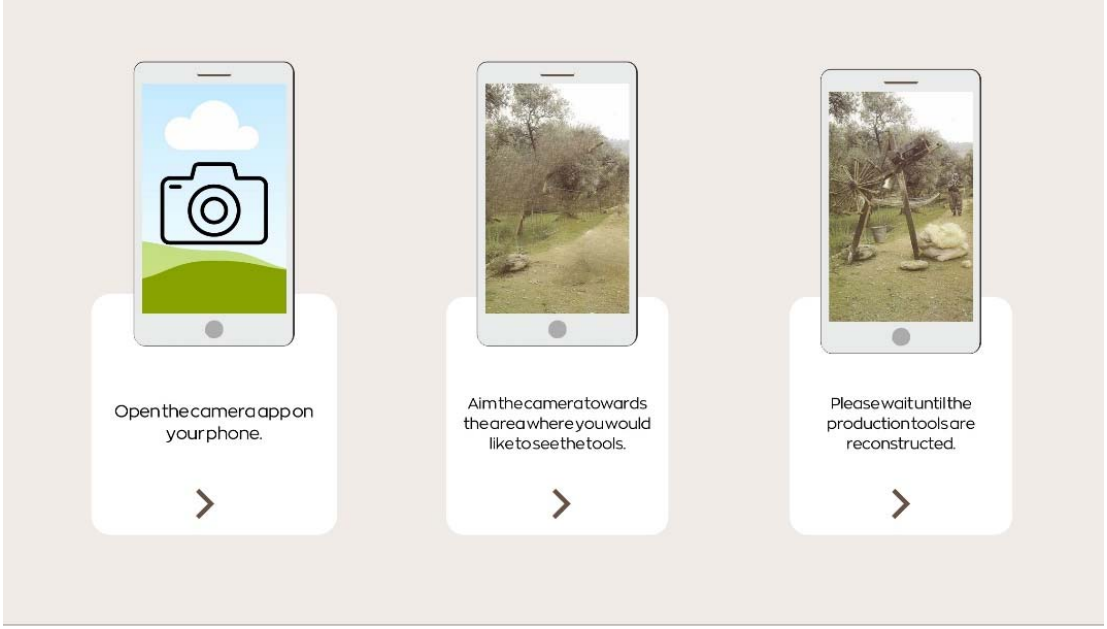

Figure 7. Use of AR in rope making (Prepared by the authors).

Figure 8. Remote experience page in rope making, (Prepared by the authors).

3.3.3. Life in Tire

The overarching theme, centered on the essence of Life in Tire, is divided into four sub-themes: religion, traditions, domestic life, and food heritage. The religious aspect encompasses significant sites such as mosques, masjids, tombs, and Greek and Jewish heritage. The traditions sub-theme highlights unique cultural practices, including bathing traditions, coffee house gatherings, Hıdırellez and Navruz celebrations, and camel wrestling. The domestic aspect delves into the architectural richness of specific mansions and traditional houses. Finally, the food sub-theme introduces visitors to local delicacies such as Tire-style Meatballs (*Tire Şiş Köfte*), Well Kebab (*Kuyu Kebabı* or *Taktak Kebabı*), Keskek (*Keşkek*), Tire Toast (*Tire Tostu*), Mud Cheese (*Çamur Peyniri*), and Melon Seed Sherbet (*Sübye Şerbeti*).

For this study, the focus is on the "tradition of bathing", offering visitors two route options: one for conservation experts and one for tourists. In the route for experts, there are baths in good condition as well as those

in ruins. On the route for tourists, only the baths in good or average condition are included. Visitors can also further personalise their experience by selecting layers based on the original or refunctioned of these bathhouses (Figure 9).

Figure 9. Personalisation page for the bath route experience, (Prepared by the authors).

The auditory experience enriches the journey, with keynote sounds such as water filling a basin and signal sounds such as the metallic resonance of a bowl placed on marble, enhancing the ambiance. Additionally, visitors can listen to narrations, such as Evliya Çelebi's historical accounts of Tire's baths, or the fictionalised "Story of Tire Baths: Following the Traces of Water" (Figure 10). Augmented reality (AR) features add a transformative dimension, allowing users to visualise the restoration of incomplete architectural elements when pointing their cameras at ruined bathhouses.

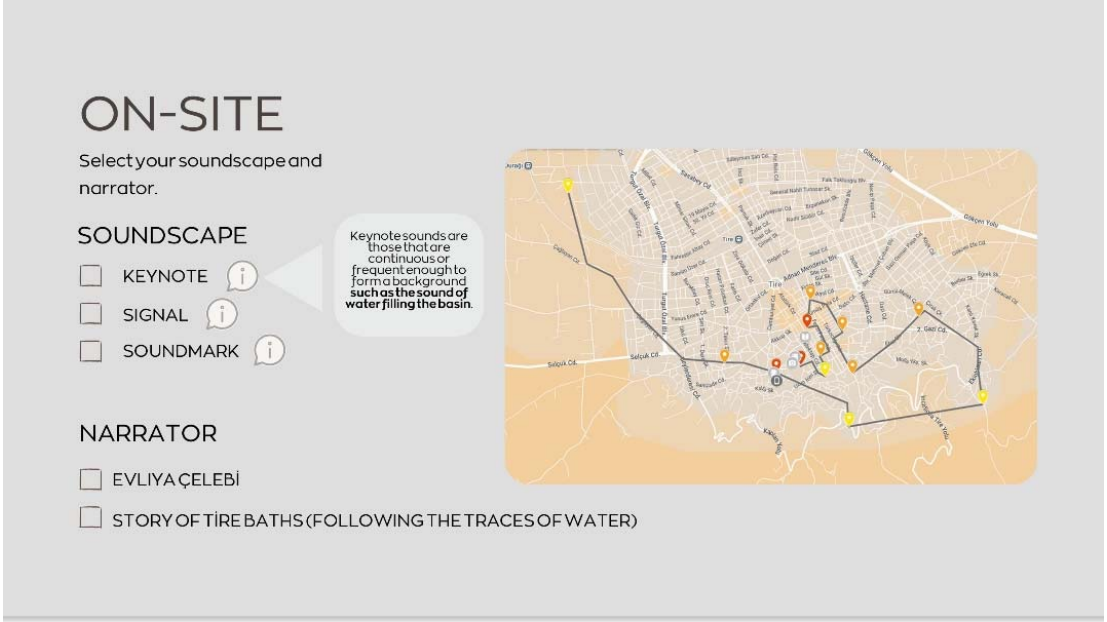

Figure 10. Sound and narration type selection page (Prepared by the authors).

For remote access, interactive plans of bathhouses enable users to explore spaces through 360-degree videos and 3D photographs. Informational panels provide details about tools and objects used in traditional bathhouses

(Figure 11). Storytelling elements create a vivid sensory experience, describing the warmth, sounds, and visual richness of the spaces.

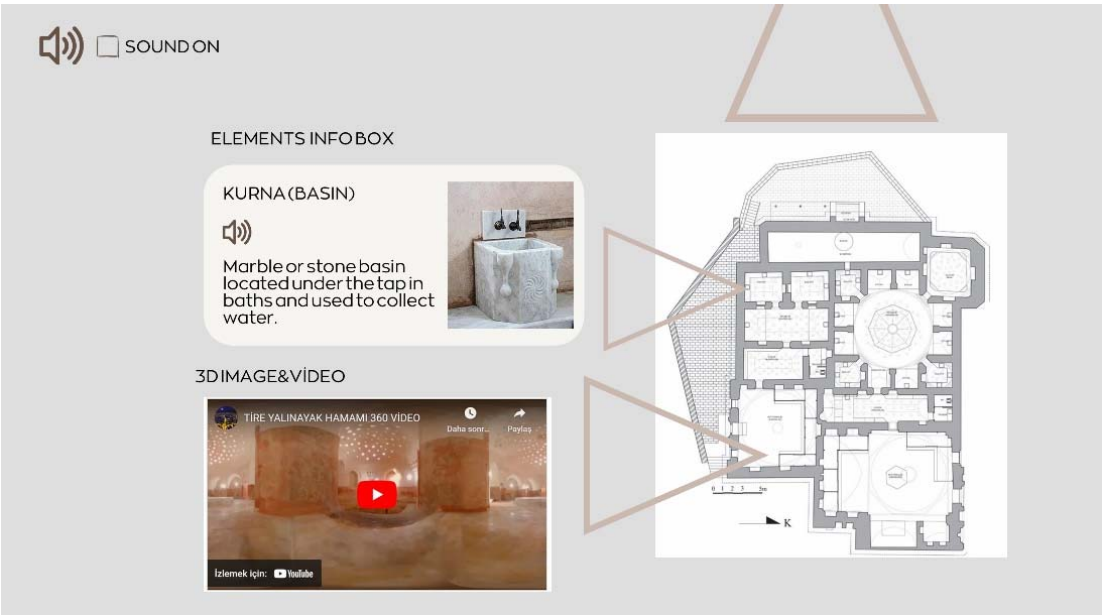

Figure 11. Remote experience page in bathing tradition (Prepared by the authors).

By blending on-site and remote experiences, this initiative preserves Tire's cultural legacy while fostering a deep, interactive connection for visitors.

4. DISCUSSION

The study was discussed under the following headings heritage values, comparison of the proposed digital routes for Tire with similar examples, and evaluation of international cultural route documents.

4.1. Heritage Values

The ethnobotanical practices, rope-making craft, and bathing traditions of Tire collectively embody significant values that emphasise the region's cultural, historical, and economic heritage. These themes are deeply interwoven with the natural and socio-cultural fabric of Tire, reflecting a broad spectrum of values that underscore their importance.

The ethnobotanical practices of Tire highlight the use of naturally occurring plants and the maintenance of traditional methods that preserve the region’s ecological and cultural identity. The aesthetic value of this tradition is evident in the preservation of the landscape and the vibrant displays of fruits and vegetables in the traditional market. The rarity value is emphasised by the endemic plant species thriving in the mountains, which also contribute to the environmental value by fostering biodiversity. Moreover, the cultural value is rooted in the tradition of herb gathering, where these plants are used for culinary, medicinal, and craft purposes. The enduring functionality of these practices, sustained through the Tire Market, represents the continuity value, while the economic value is evident in the regional and local trade of these products, emphasising the symbiosis between nature and community livelihood.

The craft of rope making further exemplifies the region's multifaceted values. Handmade products, such as rope bags, reflect the aesthetic value of this craft. Rooted in the *ahilik* (the traditional Anatolian guild system), the craft embodies a cultural value, fostering intergenerational knowledge transfer and ethical market practices. Historically, Tire was a prominent trade hub during the Ottoman era, with rope production playing a vital role in both local and international trade. This underscores the craft's historic value, further enriched by Mahmud II’s decree on hemp cultivation. The persistence of these traditional crafts, though reduced, signifies the continuity value, while the

sale and trade of these crafts have historically supported the economic value, contributing to Tire's prominence as a regional economic center.

Similarly, the tradition of baths in Tire reflects a profound interplay of values. The aesthetic value is highlighted through the preservation of the historical urban fabric and architectural features. Unique features, such as the pool (*mikvah*) in the Yalınayak Bath, emphasise the rarity value of this heritage. The detailed decorations of the baths and the traditional use of handmade clogs underscore their artistic value, while the cultural value is rooted in pre-wedding celebrations and other communal rituals. The construction of baths between the 14th and 17th centuries, reflecting Ottoman architectural characteristics, affirms their historic value. Although many structures have fallen into disrepair, their potential for restoration highlights their continuity value. Lastly, the economic value of baths, historically significant through their operation, now lies in their potential to attract tourism, offering sustainable economic opportunities for the region.

4.2. Comparison of the Proposed Digital Routes for Tire with Similar Examples

Guiding, informative, and experience-enhancing presentation elements are digitally designed to enrich users' experiences, whether accessed on-site or remotely. The proposed routes in Tire are compared with other cultural route examples based on various factors. These include the digital platforms where materials are presented, as well as the digital tools used to present the materials (Tables 2 and 6). It is planned to use all digital tools on three routes proposed for Tire. These tools will provide the opportunity to revive the past, provide effective learning by actively using the senses, increase user interaction, and enable individuals to reflect their own preferences on routes. Thus, effective experience will be offered both on-site and remote along cultural routes.

Table 6. Digital presentation type in TiREASURE (Prepared by the authors).

	Digital Platform			**Digital Tools**									
				Direct Senses								**Indirect Senses (smell, taste, touch stimulate)**	
				Visual			**Audial**		**Visual+Audial**				
Routes	**Website**	**Social Media**	**Mobile Application**	**Photo Text and Map**	**Map with numerous filters**	**Virtual tour**	**Storytelling (historical or fictional**	**Ambient sounds (keynote,**	**Virtual tour with audio**	**Serious games**	**Videos**	**Visual (with picture or video)**	**Auditory (with sound or narration)**
Ethnobotanic Route in Tire													
Rope Making Route in Tire													
Bath Tradition Route in Tire													

4.3. Evaluation of International Cultural Route Documents

The ICOMOS Charter on Cultural Routes (2008) outlines principles and methods for preserving and promoting cultural routes. In today's digital age, the charter could benefit from updates to reflect technological advancements, enabling a more dynamic and accessible approach to cultural heritage. The principles in the current charter have been adapted to align with the digital transformation and can be listed as follows for digital cultural routes. Context and Content: Digital cultural routes are grounded in natural and cultural settings, transforming heritage assets into digital formats for global access. These routes must integrate traditions, beliefs, and historical narratives alongside physical elements to ensure cultural unity. Furthermore, the development of thematic sub-routes that allow individuals to select based on their preferences can enhance visitors' sense of belonging to the place and its culture.

Dynamic and Holistic Approach: Digital tools must preserve the spirit, traditions, and physical heritage while continuously updating to bridge the past and present. A unified digital representation creates accessible and immersive cultural environments. In achieving this, it is essential to engage multiple senses; while a digital experience may not fully replicate an on-site visit, it should be holistically enriched through sensory integration. Among the senses, visual and auditory elements are the most readily transferable to digital formats. Although visual tools are widely utilized, sound remains underrepresented in contemporary digital route presentations. Some existing examples incorporate ambient soundscapes and historical or modern storytelling, though only to a limited extent. Enhancing the effective use of auditory and visual tools could further support the transmission of other sensory experiences, such as taste, smell, and touch, through narrative techniques. Future research could explore innovative approaches, such as integrating three-dimensional texture data into digital platforms, allowing users to reproduce tactile elements via 3D printing, thereby expanding the sensory dimensions of digital cultural routes.

Integrity and Authenticity: To maintain the authenticity of natural and cultural heritage sites, it is possible to preserve them by supporting intangible assets, even if the physical ones have not survived. Through digital techniques, this preservation can be animated while ensuring authenticity. By integrating both tangible and intangible heritage into digital cultural routes, a holistic representation is achieved. At the same time, it is essential to document and update the physical environment digitally. The authenticity of heritage should be assessed based on its location, design, materials, construction techniques, function, and traditional aspects. Authentic heritage should be promoted in a controlled manner, ensuring its value is recognised while maintaining its originality. For heritage with diminished or lost authenticity, digital tools such as augmented reality can supplement tangible and intangible elements. Rather than creating imitative reconstructions, the focus should be on conveying historical qualities to future generations. Additionally, the integrity of heritage should be evaluated based on its elements, size, and management. Heritage that retains its integrity should be supported by digital representations that reflect its broader context. For heritage with compromised integrity, digital representations of the ideal form can serve as a basis for future preservation strategies.

Methods and Tools: Understanding and evaluating cultural and natural routes through the tools of heritage conservation is essential. To achieve this, it is important to systematically analyse both tangible and intangible elements. This includes assessing their historical and current status. Tangible aspects consist of places, materials, tools, and users, while intangible elements encompass processes, usage patterns, sociocultural characteristics, as well as the types and stages of sounds. These elements should be systematically defined, potentially using a table format tailored to the type of heritage being assessed. The evaluation process must prioritise authenticity and integrity, ensuring that digital representations accurately reflect the distinctive features of the route and support its preservation. Digital content should not only convey the identity of the route but also help maintain its authenticity and integrity. Interactive tools such as augmented reality, environmental soundscapes, multisensory storytelling, interactive maps, visual and 3D models, and serious games can enhance user experience while reinforcing the cultural significance of the route. These tools should emphasise the interconnections between heritage assets and their narratives. A dynamic digital platform can ensure continuity and enrich users' experiences both remotely and on-site.

Collaboration and International Cooperation: The creation of digital cultural routes relies on international cooperation in technical expertise, financial support, and information sharing. Such collaborations enable the effective documentation and digital transformation of shared cultural heritage, ensuring its preservation. While this study focused on conceptual design and user interface development rather than full implementation, interdisciplinary partnerships could facilitate its realisation. By integrating these elements, digital cultural routes not only safeguard cultural and natural heritage but also enhance accessibility and global appreciation.

5. CONCLUSION

Addressing the dual challenges of heritage abandonment and the threat of over-tourism, this study developed a holistic model that supports both on-site and remote access while enhancing user interaction. Traditional presentation methods often prove insufficient in the current context; therefore, this research proposes replacing them with innovative, multi-sensory techniques such as storytelling, video, and 3D visualisations. A critical gap identified in existing routes is the underutilisation of intangible elements, particularly sound. Consequently, the proposed model prioritises connecting communities with their heritage by integrating realistic ambient soundscape recordings, augmented reality (AR) experiences, and storytelling into interactive maps. In order to apply this model, the TiREASURE App was planned as a unified platform that combines various digital tools. This platform aims to foster

deep user engagement through personalised routes, time-lapse photo contributions, serious games, and systematic feedback mechanisms, thereby supporting the sustainable management of regions lesser known, e.g. Tire.

Within the scope of the Tire district, the research focused on three thematic sub-routes: Green Tire, Tire on the Silk Road, and Life in Tire. A key finding is that digital intervention strategies must be tailored to the specific authenticity and integrity levels of each site, determined through conservation discipline tools. For the ethnobotanical practices theme (Green Tire), which retains high integrity, a digitally enhanced on-site experience is recommended, balanced with remote access options to prevent ecological damage from excessive visitor traffic. Conversely, for the rope-making tradition, which has partially lost its originality, and the bathing tradition, which has significantly lost integrity, the study demonstrated that AR-supported digital narratives are indispensable for revitalizing these lost layers of history and ensuring their conservation.

Inspired by global insights from European Commission HORIZON Projects, this study proposes a forward-thinking and adaptable model applicable to various cultural routes worldwide. Future research should expand on this foundation by focusing on techniques to preserve and present all sensory attributes of routes, including sight, hearing, touch, taste, and smell. While digitalisation techniques such as AR, 3D modelling, and video are effective, their implementation requires updated regulations to legitimize and standardize these tools in heritage management. Ultimately, by integrating interdisciplinary collaboration with emerging technologies, such as immersive room designs, multiplayer digital cultural games, blockchain for digital data preservation, and AI tools, this initiative offers a sustainable framework for the future visibility and long-term preservation of cultural heritage.

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Şeyma Ebrar Gülkaya: Conceptualization (equal), methodology (equal), writing - original draft (main), writing - review & editing (supporting), visualization (main), resources (main), investigation (main), formal analysis (main), project administration (supporting), supervision (supporting), validation (equal).

Mine Hamamcıoğlu Turan: Conceptualization (equal), methodology (equal), writing - original draft (supporting), writing - review & editing (main), visualization (supporting), resources (supporting), investigation (supporting), formal analysis (supporting), project administration (main), supervision (main), validation (equal).

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