

# Data Warehouse and Interactive Map for Promoting Cultural Heritage in Saudi Arabia Using GIS

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## ABSTRACT

With the urbanization of various regions, many historical sites may be misrepresented or totally neglected. As more people move to urban areas with time, heritage areas are being abandoned or ignored. The roads leading to such areas are less maintained, and they are not being adequately promoted. Over the years, the emergence and evolution of digital maps have played a significant role in tourist and cultural exploration and are important sources of information for tourists who are considering specific destinations. In this paper, the authors discuss the development and implementation of a geographic information system (GIS) in the tourism industry. They create an interactive map for tourist sites and suggest a means of retrieving tourist data. They select the Aseer region as a case study since it is rich with deep cultural heritage, comprising almost 4,000 heritage villages, and is considered to be one of the most important tourist destinations in the country. In this paper, the authors propose an initiative for the development and implementation of GIS in the tourism industry.

## KEYWORDS

GIS Techniques, Heritage Tourism, Interactive Map, Tourism, Warehouse

## 1. INTRODUCTION

As an industry, tourism is very important as it can bring significant economic and social benefits to a country or region. The tourism industry has rapidly become a cost-effective solution for struggling economies. The Saudi Vision 2030 recognizes that tourism is a major sector of the service industries and one that should be developed and promoted. Saudi Arabia is one of the oldest and most well-known countries for the richness of its historical sites. Hence, the effective promotion of tourism will contribute to enhancing the tourists' perception of Saudi Arabia as an attractive tourist destination. The historical and cultural potential of the country, which includes all socio-cultural environments with their particular traditions and customs, as well as historic villages and palaces, is the foundation of cultural tourism (Ismagilova, 2015). In Saudi Arabia, cultural heritage plays an essential role in the

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tourism industry since it is based on the Saudi community's cultural legacy. Cultural heritage sites in Saudi Arabia include archaeological sites, heritage places, villages, historical cities, museums, and geographical areas (natural heritage) (Al-Tokhais, 2020).

Over the past two decades, the promotion of tourism has continued to advance with the help of information technology; in addition, the Internet has had a significant impact on the tourism industry, especially when tourists are searching for information and services (R. A. Hamed, 2019). In most countries, Web GIS has become the main means of promoting tourism. GIS's capacity to analyze and visualize spatial and non-spatial data in the form of maps has made it an indispensable tool for the tourist industry. Web-based GIS has become a popular means of information exchange and visualization with the evolution of Web technologies and GIS. GIS can be integrated with various other technologies to create new levels of accessibility and functionality (Abel, 2012).

The Web map industry has witnessed considerable development with the advent of Google Maps. It can provide interactive mapping services involving destination-specific tourist information, which offers a new way to plan trips and access information about a destination (Pan, 2007). In particular, maps are of great value to tourists as they can convey a large amount of easily understood information accompanied by photographs of an area or site (Tallinucci, 2004). An interactive map allows the user to interact with the map by changing the view or zooming in/out. Importantly, one feature allows the user to view information about the place on the map through the pop-up. A more detailed account of the interactive map is given below.

In this paper, the authors develop and implement an interactive map intended to promote historical and tourist sites, taking the Aseer region as a case study. Currently, there is no interactive map available that promotes the cultural, historical, and tourism sites of Aseer. Therefore, an interactive map will offer a technical solution to the problem of effectively promoting this region as a tourist destination. Thus, the main motivation behind this research is to develop an interactive map involving all historical and tourism sites in Aseer. The proposed interactive map is intended to provide tourists and non-tourists with a valuable reference that provides comprehensive information and visualization of the Aseer region that will encourage tourism and exploration.

The main contributions of this paper are the development of a Web application containing an interactive map that gives tourists spatial and non-spatial information about the Aseer region. It provides information about road conditions and access to various sites in terms of difficulty. Also, the paper gives a comprehensive description of the GIS and its uses in the tourism sector using a social survey.

## **2. BACKGROUND**

GIS originated in the early 1960s when the Canadian Geographic Information System (CGIS) was developed. Innovators John Coppock and David Rhind divided the GIS development era between the 1970s and 1990s into four periods:

1. The late 1950s to the 1970s were the pioneer period of concept and software development.
2. From the mid-1970s to the early 1980s, experimental research was conducted funded by the government, with continued provision of GIS on mainframe computers.
3. The early 1980s to the late 1980s was a commercial period that involved government and industry, with companies such as Esri and Intergraph dominating during this period.
4. From the end of the 1980s to the early 1990s there was an increase in academic interest and participation, along with intense vendor competition, which reduced the number of GIS companies delivering GIS with user-friendly interfaces for desktops (Waters, 2017).

Since 2010, users have become increasingly accustomed to using GIS software and open mapping. This is the GIS era when GIS data is ubiquitous, and the online repository stores a large amount of

spatial data (Ali, 2020). In general, a GIS has three types of capabilities: database management for collecting and storing large amounts of geospatial data, spatial analysis for investigating geospatial relationships among the entities represented by that data, and map display for depicting those geospatial relationships (Saleh, 2012). GIS primarily works with spatial data related to a specific location on the earth. This spatial data can be explicit and implicit. Explicit spatial data conveys latitude and longitude, while implicit spatial data contains spatial references such as place names, addresses, postal codes, etc.

With the rapid and significant development of information technology and its critical role in the tourist business, this technology together with tourism industries are a powerful means of ensuring economic progress. Hence, numerous GIS applications have been designed for tourism purposes. Most tourist information is distributed through numerous websites on the Internet, which is challenging to use because of the broad spectrum of tourist information. Therefore, using a GIS map to display the information correctly and succinctly is the best answer to this problem (Shyti, 2012). A GIS is a crucial tourism business tool since it includes powerful tools that combine a geographic analysis with an attribute analysis (U Pandagale, 2014). The authors find that GIS applications have become an essential and practical tool for the analysis and display of coordinated data, as it can provide accurate and detailed information easily and quickly.

GIS is an information system that provides services for geographic study and decision-making, both of which may be useful in tourist management. It provides direct services for tourist management by offering functions such as data collection, storage, processing, geographical analysis, etc., enabling effective data visualization and integration. When planning their trips, tourists are greatly interested in seeking information related to specific locations; they want to learn about the available amenities, facilities, heritage places, or climate of the region they intend to visit (U Pandagale, 2014). GIS helps the tourism industry by providing digital files for the Internet and mobile maps, websites with interactive maps, maps of tourist attractions, etc. In addition, GIS provides numerous opportunities for the development of modern tourism applications using maps (Sureshkumar, 2017).

The map is a graphic representation of GIS data and offers an interactive window to all geographic data and descriptive information, as well as comprehensive spatial analytic models produced by GIS professionals. This is how GIS content is exchanged among professional GIS users as well as with the public online (Pandey, 2013). Kawasaki (2013) stated that Google Maps, Apple Maps, and Google Earth, they are developed by Keyhole and published in 2005, have played a crucial role in raising public awareness of geospatial data by allowing people to browse geospatial data through Web mapping without having to install traditional GIS software.

According to the definition provided by Andrienko (1999), the interactive map is a computerized map, shown to the user in such a way that all interactive operations are enabled, such as access to data, zoom in/out, layer selection, presentation parameter manipulation, etc. Another definition of the interactive map is given by Oymatov (2021) who described it as an electronic map that depicts a visual data system and runs in a two-way dialogue mode between the user and the computer. Moreover, the information in the interactive map is hidden from users; when they perform a certain action, the information about the area or object selected appears. Facilitated by the Web, and wireless and mobile technologies, interactive maps have become ubiquitous and are available to the average users, and are now a part of some everyday activities (Sarjakoski, 2009).

In recent years, the success of digital maps has been widely recognized. Various types of services now disseminate an increasing amount of information, such as Google Maps, Bing Maps, Yelp, and Waze, although data on the physical accessibility to a built environment is quite limited (Marconcini, 2017). The interactive map is very valuable to tourists because via one picture it can convey much information about the area in an interesting and easy-to-understand way (Tallinucci, 2004). The interactive map has been used extensively in the tourism sector. Many researchers and countries have used interactive maps to promote tourism and for other purposes (Adrees, 2015; Di Pasquale, 2013; Maiellaro, 2015; Sahahiri, 2019; Yousif, 2018).

GIS offers numerous benefits and can be used in a number of tourism sectors including tourism development, tourism planning, and tourism marketing. Tourism planning involves the integrated planning of tourism infrastructure, including attraction areas, services, and transport facilities. Tourism planning requires more spatial data collection and processing that should be described and studied geographically (Sarjakoski, 2009). According to (Shah, 2015), tourism marketing is one of the tourism fields that benefits from GIS. It enables tourism marketing stakeholders to locate and analyze the behaviors and characteristics of potential customers.

Tourism is one of the world's fastest-growing economic sectors. According to Robert O'Hanlon (2010), the Middle East is predicted to become one of the top tourist destinations in the world. The Kingdom of Saudi Arabia is the largest Arab nation in the Middle East, occupying about four-fifths of the Arab Peninsula with a total area of approximately two million km<sup>2</sup> (General Information about The Kingdom of Saudi Arabia, 2019). Also, Saudi Arabia has 13 regions that vary in topography and social-culture features. This diversity has contributed to the richness of various tourist areas and made Saudi Arabia one of the most important destinations in the world that tourists want to discover. For decades, religious pilgrimages (Hajj and Umrah) have dominated tourism activity in Saudi Arabia, with the majority of tourists coming for religious reasons (Henderson, 2011). In recent years, Saudi Arabia has witnessed considerable growth in the tourism sector. After energy and manufacturing, tourism is Saudi Arabia's third-largest industry, with an income predicted to reach SR86 billion (US\$22.93 billion) by 2029 (Damanhour, 2017). The first goal of the Saudi Vision 2030 is to attract tourists to the Kingdom's historic and natural areas. In order to reduce the locals' international travel and spending abroad, the Public Investment Fund (PIF) has encouraged domestic travel and tourism by investing in the entertainment and tourism industry (Abuhjeeleh, 2019).

After examining similar work, the authors found that, although there are papers and websites focusing on tourists' interactive maps, most of them are not concerned with heritage sites that promote cultural tourism, and none has used the Aseer region as a basis for an interactive map. Hence, in this work, the authors select the Aseer region as a case study to promote its rich culture in heritage places. One of the most important factors that distinguishes this research from others is that the condition of roads and access to various places are considered, since the Aseer region is mountainous and not all areas are easily accessible.

### **3. METHODOLOGY**

This section discusses the data collection process adopted for this project. Also, the authors explain how to build a Web app that contains an interactive map that categorizes the sites according to several features.

#### **3.1 Data Analysis and Gathering**

In this initial phase, the authors searched for information on interactive maps and their application and benefits in the tourism sector. They examined research papers and countries that have used it to encourage tourism, and websites that were relevant to the project. They also searched for the tools used to build interactive maps. They sourced information about heritage site locations from the Aseer Development Authority (ASDA). This information is presented in Figure 1. Also, they searched social media platforms and various websites for tourism data on various sites and locations.

#### **3.2 Design and Building Tools**

After collecting the necessary information about the heritage places and most famous sites in Aseer, the authors began developing the website with a user-friendly interface to encourage tourists and other users to explore the Aseer region. The authors learned how to build the website and interactive map. They found the appropriate tools for building a Web app, which are discussed in next section.

Figure 1. Aseer Region Heritage Location Information Obtained From Aseer Development Authority (ASDA)

المنطقة	اسم الموقع	نوع الموقع	الارتفاع	إحداثيات	ملاحظات
96	قرية القنطرة	منطقة أثرية	42.495513	18.213014	تحتل القرية الساحة الواقعة بين مدينتي مكة المكرمة والحدود الغربية لحدود المنطقة
96	سوق الكلال	منطقة أثرية	42.495507	18.214699	سوق الكلال، بها أحد أبرز المعالم التاريخية في مدينة أبها جنوب السعودية، ويعتبر أقدم الأسواق التي
96	حدود القصير	منطقة أثرية	42.507342	18.217965	هي عناقيد راي فيها وسيل المياه يتدفق بين جدران القصير التي بنيت في تلك الفترة من قبل قبيلة
96	حدود القلبيات	منطقة أثرية	42.497768	18.210011	حدود القلبيات من أهمها مدينة أبها، كان هذا الحدودية من أهمها مدينة أبها، كان هذا الحدودية من
96	الحدود الشمالية	منطقة أثرية	42.495704	18.219404	يعتبر الحدود الشمالي من أهمها مدينة أبها، كان هذا الحدودية من أهمها مدينة أبها، كان هذا
96	قصر شدا، تاريخي	منطقة أثرية	42.509493	18.214641	قصر شدا أو القصر الأبيض، هو المبنى الذي بناه آل سعود في مدينة أبها، كان هذا القصر في
44	قمة الشخير	منطقة أثرية	42.491962	18.219518	قمة الشخير أو قمة الشخير، هي قمة الشخير في مدينة أبها، كان هذا القصر في
96	قمة الحصنة	منطقة أثرية	41.537955	18.219193	قمة الحصنة أو قمة الحصنة، هي قمة الحصنة في مدينة أبها، كان هذا القصر في
44	برج تيجان	منطقة أثرية	42.493741	18.214606	برج تيجان أو برج تيجان، هي برج تيجان في مدينة أبها، كان هذا القصر في
96	قرية العكاس	منطقة أثرية	42.465538	18.266556	قرية العكاس أو قرية العكاس، هي قرية العكاس في مدينة أبها، كان هذا القصر في
96	مبنى الحداد	منطقة أثرية	41.672035	18.207802	مبنى الحداد أو مبنى الحداد، هي مبنى الحداد في مدينة أبها، كان هذا القصر في
44	قصر العيص في جبال أب	منطقة أثرية	42.492796	18.278743	قصر العيص أو قصر العيص، هي قصر العيص في مدينة أبها، كان هذا القصر في
96	قمة الدوم	منطقة أثرية	41.539056	18.21135	قمة الدوم أو قمة الدوم، هي قمة الدوم في مدينة أبها، كان هذا القصر في
44	قرية دجل	منطقة أثرية	42.475931	18.212333	قرية دجل أو قرية دجل، هي قرية دجل في مدينة أبها، كان هذا القصر في
96	سوق الشيوخ	منطقة أثرية	42.750345	18.229747	سوق الشيوخ أو سوق الشيوخ، هي سوق الشيوخ في مدينة أبها، كان هذا القصر في
45	قرية آل عامر	منطقة أثرية	42.794666	18.368722	قرية آل عامر أو قرية آل عامر، هي قرية آل عامر في مدينة أبها، كان هذا القصر في
96	منطقة أثرية	منطقة أثرية	42.780335	17.889274	منطقة أثرية أو منطقة أثرية، هي منطقة أثرية في مدينة أبها، كان هذا القصر في
96	قرية دار بطاش	منطقة أثرية	42.764384	17.999027	قرية دار بطاش أو قرية دار بطاش، هي قرية دار بطاش في مدينة أبها، كان هذا القصر في
96	قصر أبو ملحة	منطقة أثرية	42.495166	18.216153	قصر أبو ملحة أو قصر أبو ملحة، هي قصر أبو ملحة في مدينة أبها، كان هذا القصر في








4. SYSTEM IMPLEMENTATION

In this section, the authors describe how they built their proposed system according to the most up-to-date interactive map technologies. Because the implementation stage is the most critical step in the construction of their website, they describe it in detail and give a sample of the codes and user interfaces of the website.

4.1 Proposed System

The authors designed a website that can run on different browsers (such as Chrome and Firefox). This website contains pages describing the Aseer region to encourage visitors to explore the region. The content is easy to read and follow, and presented attractively. The most important feature of the website is an interactive map where markers are used to indicate heritage sites. The symbols and colors of the markers are used to categorize various places of interest making it easier for users to find information about them. These markers are shown in Table 1.

Table 1. Categories of Markers in Interactive Map

Heritage Site Categories	Marker Symbol
Heritage Markets	
Museums	
Parks	
Heritage Villages	
Heritage Buildings	
Heritage Neighborhood	
Heritage Mosques	

## 4.2 Implementation Process

After collecting the relevant information about the heritage locations in the Aseer region, the authors began developing the web app using suitable tools. They used Visual Studio Code as it is the most popular Integrated Development Environment (IDE) among programmers because of its high extensibility and personalization capabilities, and its ability to handle all of the tools and file types that are commonly used. The authors use it for coding different languages: HTML, CSS, and JavaScript, Bootstrap. Also, the authors used Mapbox and stored the geospatial data on Aseer's heritage places in GeoJSON format in order to build an interactive map. Mapbox is a location data platform that powers the maps of several popular apps and location services (Miller, 2020). Mapbox tools require an access token, which can be obtained by creating an account in Mapbox and copying the access token to be used in the project, as shown in Figure 2. Then, the authors declared a map variable, which positioned the view of the map in the center of the Aseer region in Abhah city according to latitude and longitude. They used GeoJSON to store and display map data, which is used by Mapbox's Web services and APIs to provide geospatial data.

### 4.2.1 User Interface Design

Not all interactive maps or map apps work as they could or should; as the general public becomes more proficient at using maps through exposure to (or reliance on) some interactive maps, they are becoming increasingly aware of the shortcomings and failures of these interactive maps due to lack of user interface design. Perhaps these shortcomings result in information displays that are inappropriately generalized, incorrectly normalized, or classified, or also perhaps the interface to the map is difficult to learn and use such as the well-publicized controversy regarding the initial release of Apple Maps (Kawasaki, 2013).

Thus, the authors display the user's interfaces by dividing them into two parts: the website with the entire pages and the interactive map with their essential functions. To attract more users, the website content is available in two languages commonly used in the area: English and Arabic. Figure 3 shows the main website page. It has a navigation bar at the top of the page. By means of this navigation bar, users can move to different sections of website: *Home* to display the home page, *Aseer* to display a brief description of Aseer, *Map* to move the user to the Aseer interactive map page, *Arabic* to replace English with Arabic, and *Logo* which takes the user directly to the *Home* page.

The *Aseer strategy* button is one of the interface features as illustrated in Figure 4. When the user clicks on the *Aseer strategy* button that appears on the home page, it immediately shows the video containing a description of the Aseer strategy using GLightbox, which is pure JavaScript that displays video with an autoplay feature.

When the user clicks on the *Activities and places* button on the home page, it directly moves it to the page containing (in the form of cards) the places they desire to visit and activities to do in Aseer, as shown in Figure 5. Then, when the user hovers the cursor over a card, it will flip and the (explore place) button appears, as shown in Figure 6.

Another user interface feature is the *explore* button which takes the user to the description page containing detailed information about the specific site, as shown in Figure 7. The description page

### Figure 2. Declaration of Map

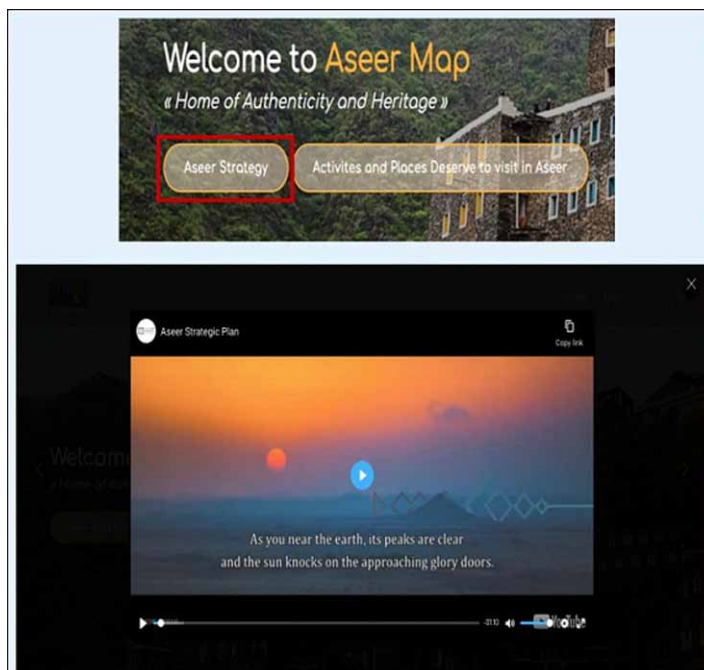
```
// create map
L.mapbox.accessToken = 'pk.eyJ0IjoiaWYyYW5lcmlEJCJhIjIsInRlZiI6ImVudHl4MWNkZWQzMDU0NGFpaTpsZS7pZS91fGJ3JTJsIDxzKCU3QmBw';
var map = L.mapbox.map('map').setView([18.792285042501857, 42.4834926106956], 7);

// create layer
var layers = L.mapbox.featureLayer().addTo(map);
```

Figure 3. Web User Interface (English Version)



Figure 4. Aseer Strategy Video



contains slideshow images to attract the user to visit the place. Also, it contains two different buttons: *Location* on the map, which directs the user to the location of a place on a Google map which allows the user to navigate to the site, and the *Back* button moves the user back to the activities and places page. The authors used the same style for all buttons used on the website. These buttons have text inside them to tell the user the response action when clicking on them. On the other hand, to enrich the user experience, the color of buttons changes when the cursor scrolls on them. Some buttons are shown below as shown in Figure 8.



Figure 5. Activities and Places Pages

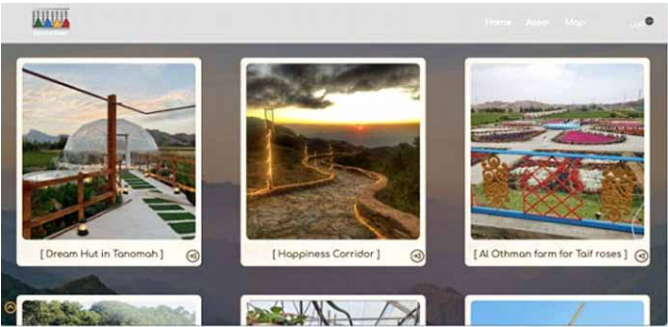


Figure 6. Activities and Places Pages With Hovers

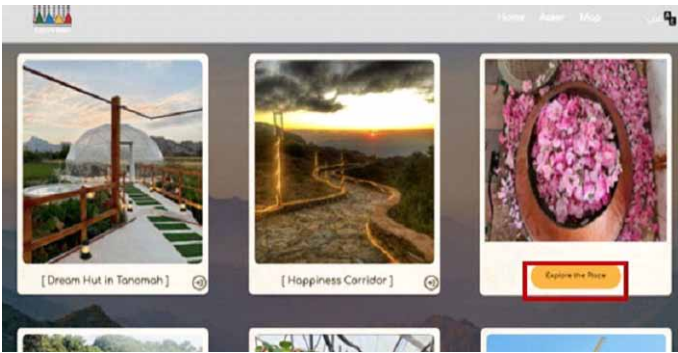


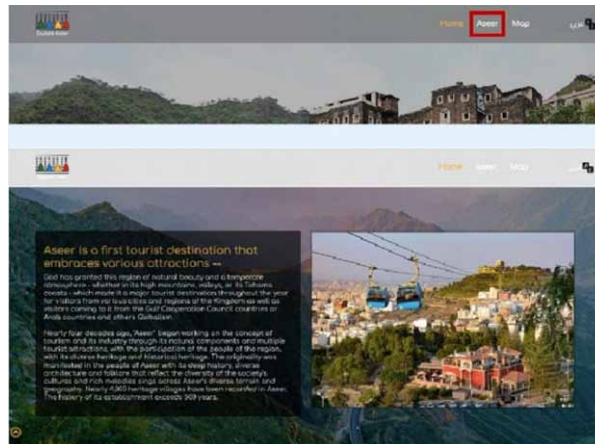
Figure 7. Place Description Page



When the user clicks on *-Aseer-* on the navigation bar at the top right of the home page, as shown in Figure 8, they are taken directly to the Aseer page that contains a short description of Aseer's natural attractions and tourism sites as shown in Figure 8. The navigation bar will be sticky on the screen when the user scrolls down to make the elements permanently on users' screens; this results in navigation across the website being more accessible for users; in addition, the color of the navigation bar changes when scrolling down as shown in Figure 8.



Figure 8. Aseer Page



Another user interface feature is the map. When the user clicks on *Map* on the navigation bar at the top, as in Figure 9, the user will move directly to the Aseer interactive map page, as shown in Figure 9. The essential interactive map page functions and their interfaces include the *Navigation* menu that contains the *Home* button which returns the user to the home page. The *Arabic* button changes the language of an interactive map from the English language and vice versa to make it easy for the user to change the language at will.

Figure 10 shows a dropdown list of options allowing the user to filter the markers on the map to make it easier to find places according to the target category. Figure 10 shows how the interactive map will look when one of these categories (Heritage Villages) is chosen. When the user clicks on one of the markers to explore the place, a pop-up menu will appear containing an image and a paragraph describing the place, as shown in the Figure 11.

The place description page, shown in Figure 12, is another user interface the authors use for the website. When the user clicks on *More* on the popup menu, a complete description of the place

Figure 9. Map Page

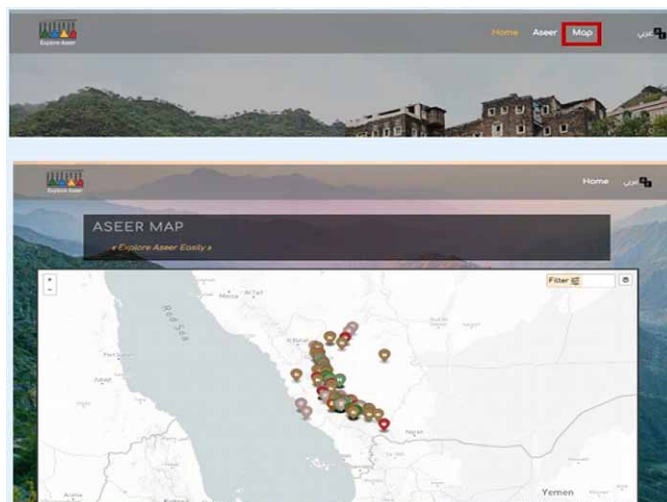


Figure 10. Example of Map Categories

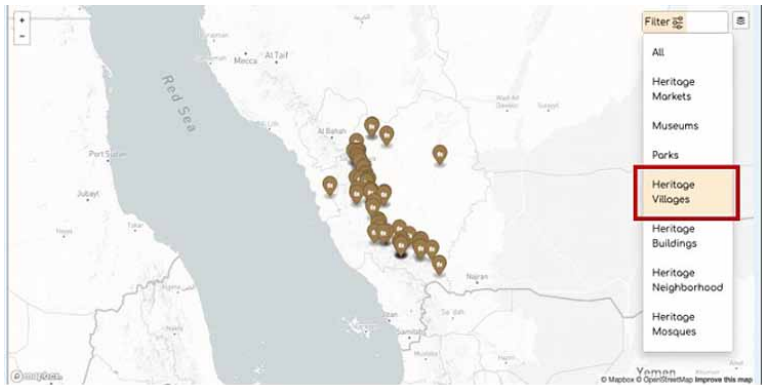
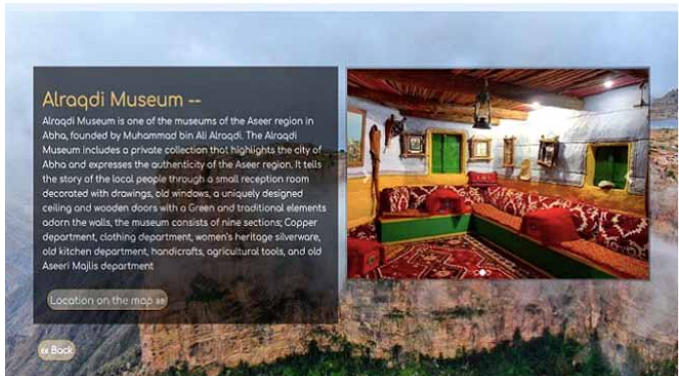


Figure 12. Result Page



appears accompanied by slideshow images to attract visitors. This page also includes two important buttons: *Location*, which takes the user to the Google Map button which allows the user to navigate to the place, and the *Back* button to return the user to the interactive map.

Another user interface feature changes the style of the map. The authors included several basic features in the interactive map. The user can choose from three map styles in addition to the basic loaded style as shown in Figure 13. Also, the authors added Zoom control that allows users to zoom in and zoom out of the map. Also, as mentioned earlier, the authors have a live change option so that the text can be changed to the Arabic language. The authors show three screenshot samples of the website in the Arabic language to illustrate the different styles of the two languages (Figures 14, 15, and 16).

#### 4.2.2 Usability Evaluation

Testing and evaluation are crucial steps following the implementation of this app. Testing helps to identify and resolve faults and flaws in the application before it is released to users. Therefore, the authors tested and analyzed their system to ensure that it functioned properly and produced the desired outcomes. Because the system is designed to attract tourists to Aseer area, the authors ensured that it is user-friendly and without complicated functions. All the functions can be used effortlessly. Furthermore, the authors used unit testing which involves evaluating and validating each unit in a system, such as the map page function testing in Figure 17.

Figure 13. Example of Map Style

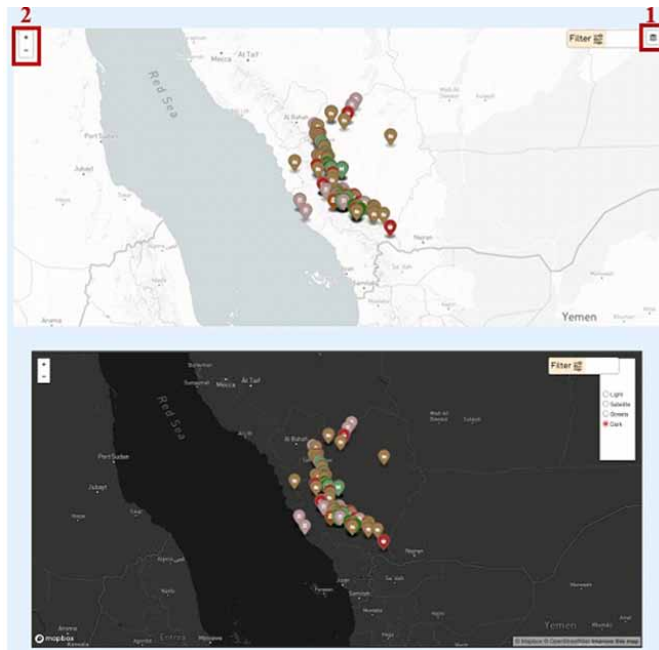


Figure 14. Home Page in Arabic Language



Also, the authors defined a set of usability evaluation parameters. The key goals were to provide an overview and allow comparison of commonly applied strategies for usability evaluation in the GIS domain. The authors adopted a lightweight usability evaluation parameter for WebGIS from Abraham (2021), which depends on two evaluates: one for the Web app usability elements and the other for the map usability elements, as illustrated in Figure 18. This is because WebGIS typically consists of a map and a website that contains the interactive map. Web contains all the text and information that describe the content, while the map visualizes the content to the map

Figure 15. Activities and Places Pages With Hovers in Arabic Language

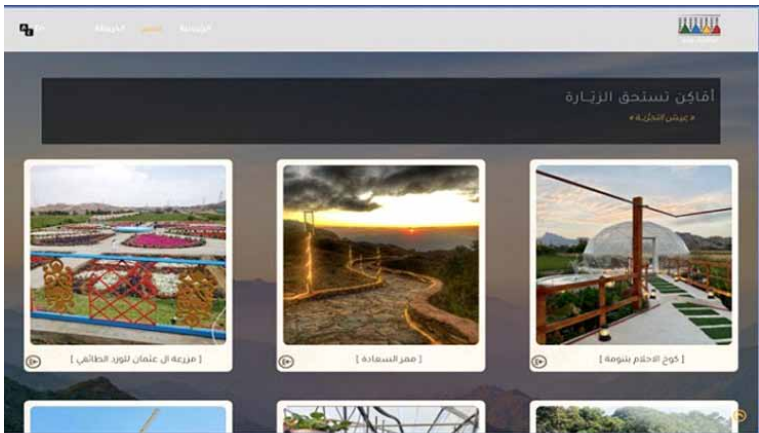


Figure 16. Interactive Map Page in Arabic Language

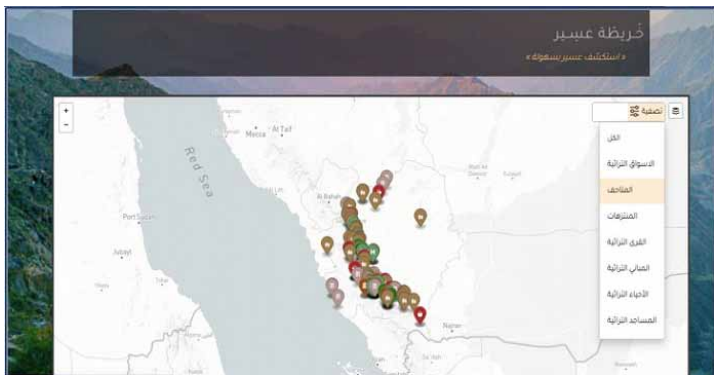


Figure 17. Example of Unit Testing Function

Unit	Result	Screenshot
Zoom in/out.	Pass	

to make the information easy to learn and use through the map. The authors provide a complete evaluation of usability in both the Web app and map according to several criteria. Tables 2 and 3 show the evaluation of usability in Web app, while Tables 4 and 5 shows how the authors evaluated the usability elements used in the map.

Figure 18. WebGIS Usability Element

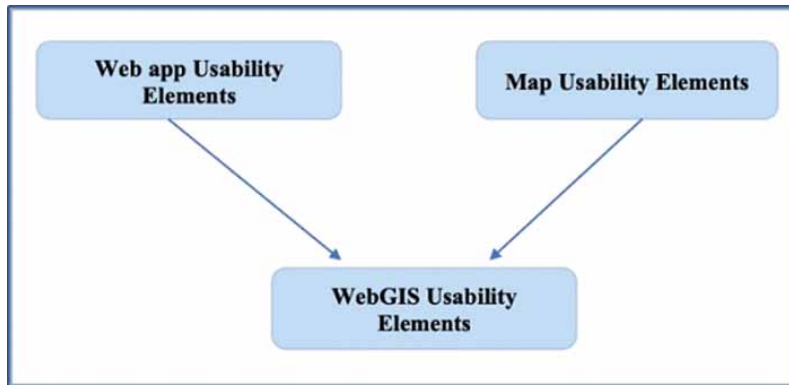


Table 2. Web App Usability Elements - Evaluation 1

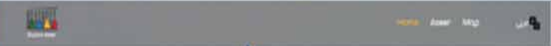
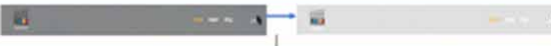
Usability Evaluation Main Elements: User Interface Elements	
Usability Evaluation Sub Elements	<b>1. Navigational components</b>
Description	<p>Describes how users will navigate (move) around the website. This also evaluates some elements in a website, such as icons that are a simplified image that guides the user to navigate across the website and the Image Carousel, which enriches the user's perception through a set of images.</p>
Evaluate Result and screenshot (If available)	<p><b>1. Navigation bar in Aseer Map web app:</b></p> <p>1.1 In Aseer Map, we adopted a simple navigation bar that contains hyperlinks to subpages of the website.</p> <p>1.2 The navigation bar contains the logo of the Aseer Map website, which alter according to the website language. Also, the layout of the navigation bar changes in accord with the website language.</p>  <p>1.3 The navigation bar will be sticky on the screen when the user scrolls down to make the elements permanently on users' screens; this results in navigation across the website being more accessible for users; in addition, the color of the navigation bar changes when scrolling down as shown in the figure below.</p>  <p><b>2. Navigation control:</b></p> <p>2.1 <b>Video display:</b> We use <b>GLightbox</b> JavaScript to autoplay YouTube video inside the website rather than open it on the YouTube page.</p> <p>2.2 <b>Back button:</b> In Description pages, we used a button to return the user directly to the previous page.</p>



Table 3. Web App Usability Elements - Evaluation 2





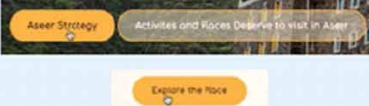




Usability Evaluation Main Elements: User Interface Elements	<p>3. Icon in Aseer Map web app:</p> <p>3.1. Change Language icon: We used the popular change language icon that indicated the existing languages used on our website</p>  <p>3.2. Back to top icon: An icon that permits users to quickly navigate to the top of the page.</p>  <p>3.3. Read more icon: Used in cards in activities page to tell the user there is more content when the cursor scrolls on the card.</p>  <p>4. Image Carousel:</p> <p>We used the image Carousel feature in the description page to give users more visualization about places through more images.</p> 
	<p>5. Input Controls:</p> <p>It is an interactive element in a user interface.</p> <p>5.1. Buttons: Which indicates an action when clicked; we used the same style for all buttons used on our website. These buttons have a text inside them to tell the user the response action when clicking on them. On the other hand, to enrich the user experience, the color of buttons changes when the cursor scrolls on them. Some buttons will show below.</p> 

Table 4. Map Usability Elements - Evaluation 1

Usability Evaluation Main Elements: Map Elements	
Usability Evaluation Sub Elements	2. Input Controls:
Description	It is an interactive element in a user interface.
Evaluate Result and screenshot (If available)	<p>2.1. Dropdown lists: Dropdown lists allow users to select one item at a time, which must be provided with a text to enable the user to recognize the action. In our map, we use this feature to filter the marker according to type, as mentioned before.</p>
Usability Evaluation Main Elements: Map Elements	
Usability Evaluation Sub Elements	3. Colors and designs
Description	It describes how will use colors and designs appropriately to attract the users.
Evaluate Result and screenshot (If available)	<p>We tried to use appropriate colors for each marker category in our map. Such as, we used dark green color to express the parks, light green to express the mosques, light brown for villages, and so on.</p> <p>On the other hand, we chose an appropriate symbol to express each marker, such as we used building symbols to represent the heritage buildings, markers with m letter for mosques, and so on.</p>

Table 5. Map Usability Elements - Evaluation 2

Usability Evaluation Main Elements: Map Elements	
Usability Evaluation Sub Elements	1. Interactivity
Description	Describes how users will interact with the elements provided on the map and measure to what extent they allow the user to interact with them.
Evaluate Result and screenshot (if available)	<p>1.1.Navigation elements</p> <p>1.1.1. <b>Zooming icon:</b> In our map, we provided a zooming icon on the upper left side of the map, which allows the user to control the zoom in/out of the view.</p>  <p>1.1.2. <b>Direct re-positioning:</b> This allows the user to reposition the view of a map by moving the mouse around the map, which is present in the map with a "hand" cursor. In addition, one of the crucial features of our map is that it can reposition the view of the map when the user clicks on one of the markers on the map, which allows the full show of the pop-up.</p>  <p>• Before click on one of the markers:</p>  <p>• After click:</p> 

5. CONCLUSION

In conclusion, since the 1990s, GIS has proven to be an important and effective means of boosting the tourism industry. GIS is helpful in various tourism areas including management, marketing, development, and promotion. The advent of interactive maps has also brought about a paradigm shift in the way that tourists plan for their trips, which includes an overview of sites with information and pictures about them. In this project, the authors proposed a system and an interactive map intended to promote and encourage visits to the heritage and tourist sites in the Aseer region by providing tourists with an alternative way to explore the places interactively. In this paper, the authors introduced the



proposed system, stated the project's objectives, and reviewed the literature relevant to the project, and similar interactive maps around the world. The authors showed how information was collected about the heritage sites in the Aseer region, with the help of the Aseer Development Authority (ASDA), which provided them with the names of sites and their longitudes and latitudes. The authors also discussed in detail what was required to build their system. They gave an overview of the system after implementation and showed how it appears to potential tourists in the Aseer region. they adopted a simple and user-friendly interface since they needed to attract tourists to explore the Aseer region effortlessly. In addition, they tested and evaluated all the functions on the website to ensure that they work as intended.

The authors introduced the core idea underpinning their project: to develop an interactive map for heritage sites in the Aseer region. They intend to include other features to improve the website and provide a comprehensive platform for tourists. The authors' future work will involve making improvements to this system and platform by expanding the interactive map to include all the tourist sites and attractions in the Aseer region, not just the heritage places. They will investigate the possibility of communicating with services and providers in these places to allow tourists to pre-book via the map function. Also, they will examine the feasibility of evaluating and reviewing these places via the interactive map.

## **COMPETING INTERESTS**

The authors of this publication declare there are no competing interests.

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