GIS-Based Design for Urban Heritage Routes

Cristina Vicente-Gilabert(✉) ⓘ, Marina López-Sánchez ⓘ,
and Mercedes Linares-Gómez del Pulgar ⓘ

Escuela Técnica Superior de Arquitectura, Universidad de Sevilla, Seville, Spain
cvicente@us.es

Abstract. The technological advances of the 21st century lead us to think about spatial designs that, even when approached from the field of architecture, could require more than physical and palpable solutions, since proposals incorporating processes of a virtual or intangible nature should also be considered. Following this line, this text presents a design methodology for a route-based spatial strategy carried out with the support of Geographic Information Systems (GIS). The strategy, based on the new tourist approaches that were accentuated after the COVID-19 pandemic, such as proximity or kilometer 0 tourism, aims to value the Historic Urban Landscape as a touristic product and brings a new vision to the way of "reading the historic city" through a system of alternative tourist routes that include urban spaces and lesser-known architecture. The route design rejects the traditional model based on the isolated visit to cultural landmarks, and the landscape is considered as the common thread of the associated architectural elements. The main contribution of this text is the presentation of a graphical methodology to project these routes based on data analysis in GIS, which uses historical, sensory and mathematical criteria generated from operations with georeferenced data. This study opens the doors to deeper diagnostic and project methodologies in which advanced graphic tools like GIS are imposed as powerful graphic means to generate new ways of offering efficient solutions to contemporary problems.

Keywords: GIS · Historic Urban Landscape · Tourism

1 Introduction

The implementation of the Heritage Smart City and the virtual world of the 21st century proposes new ways of tackling spatial problems that do not always involve physically-explicit solutions. In the field of architecture, we are beginning to open the door to new forms of space management that do not necessarily have traditional architectural interventions associated with them, but rather seek to provide solutions to spatial problems through immaterial or even virtual proposals.

In the text presented below, a design methodology to solve a spatial problem associated with tourism in urban areas will be addressed, whose project basis will take into account both scientific and creative arguments, and the result will be a new way of using urban space without resorting to physical elements.

Both the preliminary analysis and the registration of the proposal have been carried out using advanced graphic tools.

2   Background: The COVID-19 Tourism Crisis

Among the consequences that the COVID-19 pandemic is manifesting in our populations is the need to rethink the cultural tourism model in cities. Since the start of the pandemic in March 2020, the successive mobility restriction measures on different scales have led to a decline in tourism activity to unprecedented limits. In Seville's case, the latest report issued by the Centre for Tourism Data (CDT [Centro de Datos Turísticos]) regarding Tourist Activity in August 2020 indicated a 74% decrease in overnight stays compared to those made in the same month of the previous year (see Fig. 1).

Synchronously with this new debate on tourism management in the recovery of the health crisis, a new field of opportunities arises that has barely been explored: that of the tourist use of cities by the inhabitants themselves [1]. The perimeter confinements have allowed citizens to play the role of cultural consumers of their own cities, seeking alternatives for cultural leisure within their confined perimeters [2]. To echo this fact, we propose delving into the concept of "Tourism km 0", an alternative for taking advantage of cultural spaces to rediscover them safely and sustainably [3]. The expectations placed on its consolidation, even after recovery [4], opens up a new space of opportunity in which to think about alternative ways to "read" the city. The new cultural activities must allow city dwellers to enjoy their heritage and landscape beyond the well-known and overly assumed tourist discourses.

It will possibly be necessary to dematerialise the previous media, concentrated on the usual tourist focuses, and commit to a decentralised model that is committed to the city and enhances the public space and Historical Urban Landscape [5]. In this way, we will influence the understanding of the city through routes that allow us to recognise the flow, internal connection and identity of its cultural heritage.

Fig. 1. Small queue of visitors at the entrance door to the Royal Alcázar of Seville during a period of perimeter lockdown, 2020 (own creation).

3   Goal and Approach

The goal of this study is to introduce a design methodology mainly based on advanced graphic tools, which proposes for both visitors and residents a new way to "read" the historic city. This methodology is aimed at enhancing both the heritage elements that remain outside the usual tourist routes, as well as the landscape of the historic city, also understood as heritage. To do this, it proposes a system of cultural routes that uses the landscape as the common thread of the visit, from which the different landmarks are linked.

To put this into practice, a practical example is developed to project cultural urban routes using the city of Seville as a model. In it, we will use Advanced Spatial Analysis (ASA) techniques through Geographic Information Systems (GIS) as a resource to improve knowledge of the city and its dynamics. The GIS are a powerful and effective tool for studying the city and territory. However, they have not been traditionally used in the field of architecture. From the perspective of cultural heritage [6, 7], they also facilitate the visualisation of historic narratives and research into architecture and its environment [8].

In the case of tourism, there are multiple studies focused on the assisted design of cultural routes through GIS. However, its convergence with the discipline of Architecture in the field of enhancing heritage and cultural landscapes is rarely explored. On the other hand, 'nowadays, the presence of digital tools in Architecture is undeniable, which makes it convenient to advance the understanding of the role they play, not only in the process of representation or analysis, but also in the very heart of the design process' [9].

4   Presentation and Development of the Proposed Methodology

The methodological process followed has two main phases:

1. Previous analysis using ASA: this empirical part of the process consists of carrying out a GIS-based analysis to obtain a diagnosis of the existing spatial problems, as well as the opportunities offered by the context. It is based on mathematical operations performed through the ArcGIS software on georeferenced data. These data have been obtained from public sources.
2. The design: going beyond the mathematical criteria provided by the GIS in the previous phase (distance, duration, etc.), others related to the perception of the Urban Landscape and experience of visiting historical landmarks have been addressed, understood in their historical and spatial context.

4.1   Advanced Spatial Analysis of Tourist Activity

As said, the objective of this first phase was to diagnose the tourist phenomenon in Seville from a spatial point of view. To do this, the analytical possibilities offered by GIS through the ArcGIS software were used.

Firstly, pedestrian accessibility to the cultural landmarks of the city of Seville has been studied, also taking into account their concentration in the space of the historic city.

To do this, the isochronous areas that can predict pedestrian accessibility to the main landmarks have been obtained on ArcGIS through a Network Analysis (see Fig. 2). The process has been as follows:

Once the base layers have been obtained and adapted, the influence areas of the cultural-tourist landmarks have been obtained. These landmarks consist of: Assets of Cultural Interest, monuments declared World Heritage Sites and Museums. Their influence areas correspond to proximity buffer zones based on the time it takes to get to the cultural-tourist landmark. The buffer zones have been obtained using a three-step Network Analyst procedure:

a. First, a dataset has been created in ArcCatalog with the street layer where the lengths and circulation speed of the roads had previously been added in the attribute table. This information allows the time it takes to travel each road to be understood accordingly.

b. In ArcMap the Network Analyst tool "New Service Area" has been used to determine the areas that are located at a specific amount of time from the outbreaks (1, 2, 5 or 10 min).

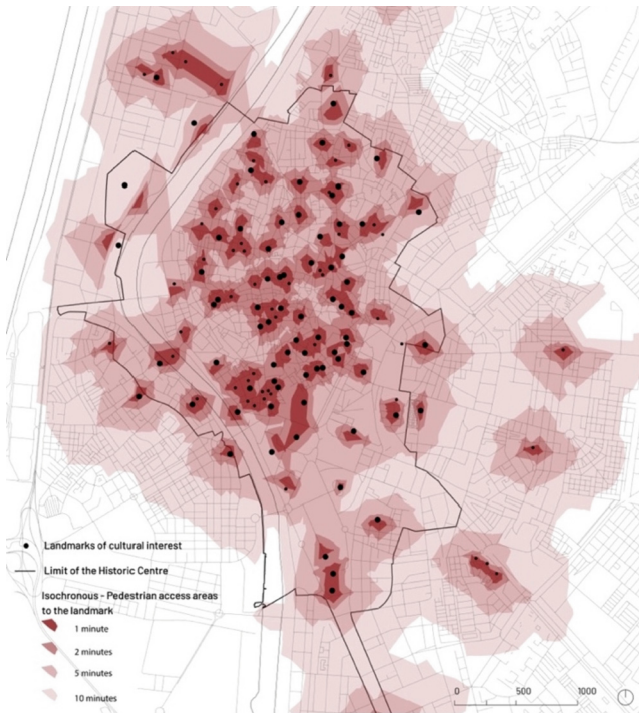c. Finally, the new layers obtained, which contain the arrival time areas in their attributes, have been exported.

Fig. 2. Analysis of pedestrian accessibility to cultural landmarks according to isochronous areas. Plan prepared with GIS (own creation).

Shown in the image is a simplified result of the analysis conducted where the cultural landmarks chosen are buildings declared Assets of Cultural Interest and Museums, as the information available in public inventories has been used. Around them we can see isochronous areas of proximity on foot at 1, 2, 5 or 10 min. This analysis allows us to conclude that there is great pedestrian accessibility to the Assets in the historic centre, given that when the spots of the isochronous areas overlap, we can see that the minimum distance to a heritage or cultural asset in the historic centre is five minutes.

Secondly, the concentration of tourist activity has been studied through the analysis of visits to the city's cultural landmarks. Observing the resulting map (see Fig. 3), the black circles indicate the number of visits received in the year according to official statistical data from Seville's Centre for Tourism Data. The cultural landmarks whose number of visits has not been officially published due to being considered negligible have been represented in dark red.

The conclusion is that, despite being a homogeneous distribution of landmarks in the historic centre, as was proven in the first analysis, the most intense tourist-cultural activity is disproportionately concentrated in the southern area, especially at the Alcázar and the Cathedral.
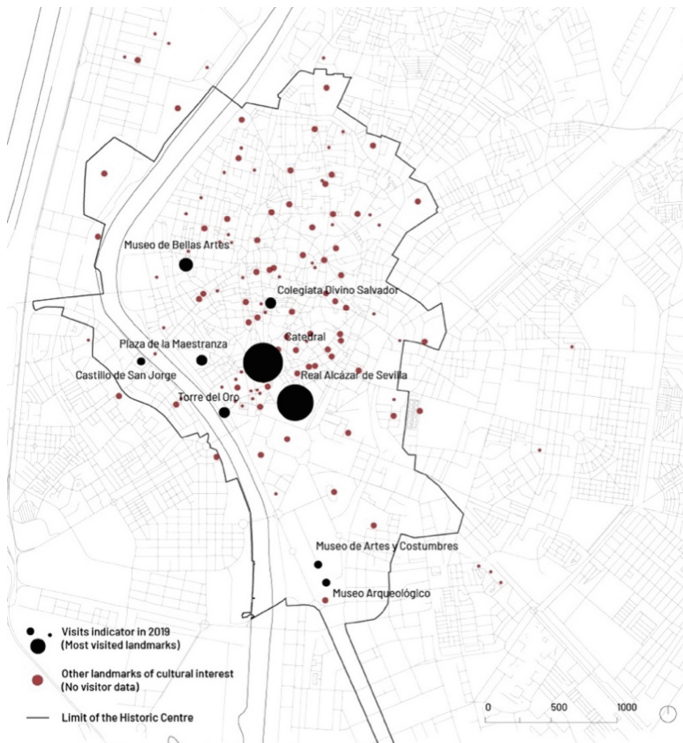

Fig. 3. Analysis of the proportion of visits to the most visited cultural landmarks in Seville in 2019. Plan prepared with GIS (own creation).

4.2   Design of the Route System

This second phase starts from the previous spatial analysis and is based on the mathematical, historical and sensory criteria that have been summarized in the Table 1. The mathematical criteria are those obtained from public sources and the spatial operations carried out in GIS; the historical ones have been acquired from the study of mainly graphic historical sources (principally cartography, planimetry and iconography); lastly, the sensorial ones are those found from the personal experience of living in the place.

Table 1. Classification of the criteria used for the routes project

Mathematical	Historical	Sensory
History of number of visits in the last years	Concentration of landmarks	Interesting points of view
Length of the route	Historic streets	Spatial sensation
Arrival time (isochronous)	Axis of city development	Pedestrian streets
Distance to other tourist facilities	Public spaces where activities with historical value still take place (markets, fairs, etc.)	Iconic urban landscapes
	Historical boundaries of landmarks	Security Perception
	Streets that are connected with historical roads that continue in the territory	Ambiental comfort taking into account climatic aspects (for example, shady or covered spaces)
	Public spaces where historical urban rites are celebrated	Alternative (ex. leisure) activities

Taking into account the conclusions drawn from the spatial analysis of the ASA step, a proposal for grouping landmarks into a system of short walkable routes has been designed (see Fig. 4).

The proposal seeks to balance the distribution of tourist activity in the city centre and incorporate less-frequented architectures and spaces into this activity, with the Historic Urban Landscape (HUL) functioning as the driving force of the visit.

Moreover, the presentation of this route system aims to become a useful instrument for expanding the city's tourist-cultural offer, creating, as we stated in the introduction, offers that are also attractive to the local tourist or local visitor. Thus, the lesser-known architecture such as the historical landscape of the city, its public spaces and roads with historic value are enhanced, providing a more contemporary way of getting to know the heritage: through its landscape.

After the creation of the route system, the trails were registered in GIS in order to obtain a georeferenced record of them and to be able to carry out spatial operations with them. Below, a descriptive table is shown with the proposed routes and the details of
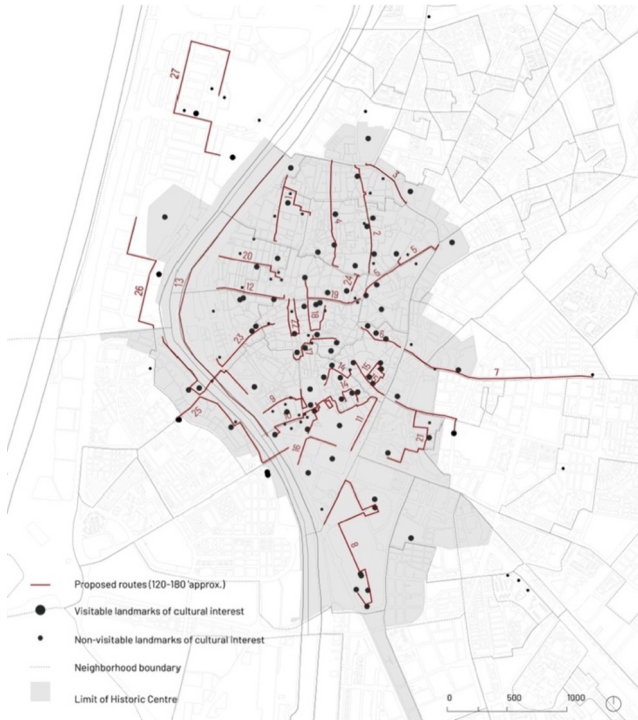
Fig. 4. Proposal of urban routes in the city of Seville. Plan prepared with GIS (own creation).

each of them (identification number on the map, name of the route, time including the visit to the associated heritage landmarks, and travel time on foot and by bicycle) (Table 2).

Finally, the detailed development of one of the routes is shown as an example (see Fig. 5).

The selected case is that of Calle Santa Clara, considered an important historic road due to being aligned with the historic northern access to the city of Seville. This street also has an interesting urban landscape characteristic of the historic center of Seville.

The main heritage assets that this route links are the Monastery of San Clemente, the Convent of Santa Clara and the gardens and tower of Don Fadrique, Bucarelli Palace the House of Mermaids (*Casa de las Sirenas*) and the San Lorenzo Church.

For the creation of the route, the previously presented criteria have been taken into account so its final layout has been articulated including other interesting spaces as well. For example, San Lorenzo square has been included because in addition to being considered an historical urban space, it currently has much activity, since it gives access to the aforementioned church of San Lorenzo and the Basilica of Jesús del Gran Poder. The latter, despite not being declared an Asset of Cultural Interest as architecture, houses one of the main works of Sevillian Baroque imagery, as well as being an image that generates great devotion among religious people: the Christ of Jesús del Gran Poder (made by Juan de Mesa in 1620). In addition, this square is characterized by having

Table 2. Descriptive inventory of proposed routes.

N.	Name	Time including possible visits (min.)	TT* (min.) (On foot)	TT* (min.) (By bicycle)
1	Santa Clara street	(2 items) 120–180	13	5
2	San Luis street	(4 items) 60	12	5
3	North walls	(2 items) 30	12	5
4	Feria street	(2 items) 30	12	5
5	Sol street	(4 items) 120–180	11	4
6	San Esteban	(3 items) 120–180	5	2
7	Road to Carmona	(1 item) 120	21	8
8	María Luisa park	(7 items) 60–240	22	11
9	Indies Archive	(1 items) 60	9	3
10	Gold Tower (*Torre del Oro*)	(2 items) 120–180	7	3
11	Royal Alcázar surroundings	(3 items) 120–180	22	8
12	Alfonso XII street	(3 items) 60–180	8	3
13	River landscape	–	60	20
14	Santa Cruz neighbourhood	(4 items) 60–120	9	4
15	Santa María la Blanca street	(4 items) 60–120	11	4
16	San Telmo-University of Seville	(2 items) 60–180	6	3
17	City Hall-Salvador square	(3 items) 60–120	5	2
18	Cuna street-Dueñas Palace	(4 items) 60–180	7	3
19	Laraña street	(1 item) 30–60	8	3
20	Baños street	(2 item) 30–60	8	3
21	San Bernardo neighbourhood	(3 item) 60–120	19	8
22	Sierpes and Tetuán streets	(1 item) 30–60	9	3
23	Arenal	(2 item) 30–60	16	6
24	María Coronel Street	(2 item) 60–120	3	1
25	Triana neighbourhood	(6 item) 60–180	17	7
26	Cartuja 1 - Monastery	(2 item) 60–120	16	6
27	Cartuja 2 - Expo '92	(2 item) 60–120	26	10

*TT: Travel Time. The time it takes to travel the route without taking into account the visit to the heritage landmark.

much activity linked both to the restaurants and tapas bars that surround it, and to the ceremonial activities of both churches.

Another urban space that has been added is the Alameda de Hércules, as it constitutes an interesting historical urban space that is very active today, which also has a large number of restaurants and recreation areas.
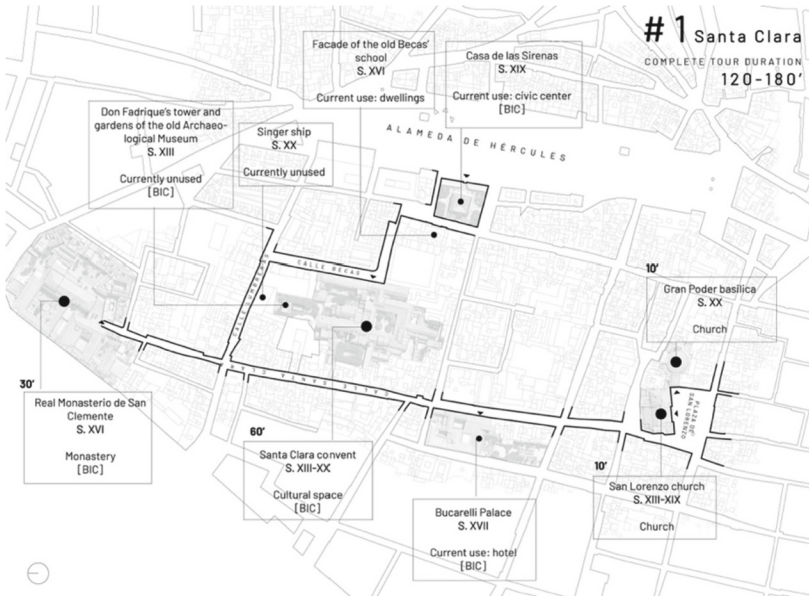

Fig. 5. Detailed development of Route 1: Santa Clara (own creation).

5   Conclusions and Future Developments

This study proposes an initial method for reading the city not through physical architecture but through intangible strategies. Therefore, it is considered the starting point of a line of research in which one of the first steps would be to delve more deeply into the spatial criteria, as well as to obtain a more detailed development of each route with its following implementation in GIS.

One of the great advances of the proposal is that not only are objective aspects taken into account, but it also involves a sum of criteria that culminate with the architect's inherent creative process.

The study shows the potential of Geographic Information Systems as a framework for designing routes from which cultural heritage can be understood in its context. Although there are numerous contributions regarding the use of GIS in fields such as geography, archaeology and tourism, the contribution of this study focuses on incorporating the tool into the creative process of the route design for the contextualisation, activation and revitalisation of the architectural heritage and public space of the historic city. The suggested method is as follows:

1. Geo-referenced record of landmarks and data relating to their activity.
2. Diagnosis made through ASA techniques in the GIS (in this case, pedestrian accessibility to assets and the concentration of activity).
3. General and detailed design of the routes, attending to mathematical, historical and sensitive arguments.
4. It is hoped that this critical and methodological contribution can serve as a reference for its application in other cases of tourist-centric historic cities.

Opening this study up to alternative future developments, its geo-referenced record could be conveyed to applications that facilitate the creation of interactive maps, which include all information needed for a complete contextual understanding, even incorporating interactive 3D infographics of the buildings of interest [10], created for example using BIM (Building Information Modelling), which in turn facilitate the spatial understanding of the architectural heritage [11].

References

1. Llurdes, J.C., Romagosa, F., Díaz, I.: Las micro y pequeñas empresas turísticas y la protección del patrimonio cultural en clave de sostenibilidad. ROTUR Revista de Ocio y Turismo **15**, 119–138 (2021)
2. Romagosa, F.: The COVID-19 crisis: opportunities for sustainable and proximity tourism. Tour. Geogr. **22**, 690–694 (2020)
3. Ioannides, D., Gyimóthy, S.: The COVID-19 crisis as an opportunity for escaping the unsustainable global tourism path. Tour. Geogr. **22**, 624–632 (2020)
4. Benjamin, S., Dillette, A., Alderman, D.H.: "We can't return to normal": committing to tourism equity in the post-pandemic age. Tour. Geogr. **22**, 476–483 (2020)
5. UNESCO: Recommendation on the Historic Urban Landscape. In: 2011 Paris General Conference Proceedings, Paris, pp. 60–65 (2011)
6. Ottomano Palmisano, G., et al.: Greenways for rural sustainable development: an integration between geographic information systems and group analytic hierarchy process. Land Use Policy **50**, 429–440 (2016)
7. Scandiffio, A.: Mapping spatial quality of slow routes with GIS-based method a comparative assessment of alternative routes. Int. Arch. Photogramm. Remote Sens. Spat. Inf. Sci. **XLII-2/W15**, 1071–1076 (2019)
8. Selva Royo, J.R.: Del dibujo a mano alzada a los SIG: representación y caracterización gráfica del campus de la Universidad de Navarra. Expresión Gráfica Arquitectónica **35**, 54–65 (2019)
9. López Sánchez, M., Tejedor Cabrera, A., Linares Gómez del Pulgar, M.: Arquitectura y Sistemas de Información Geográfica: hacia un proyecto de paisaje informado. Proyecto Progreso Arquitectura **22**, 72–87 (2020)

10. Cabezas, M., Montes, F.P.: Reconstrucción virtual de la fortaleza bajomedieval de Aguilar de la Frontera. Expresión Gráfica Arquitectónica **35**, 236–247 (2019)

11. Barba, S., et al.: BIM-oriented modelling and management of structured information for cultural heritage. In: Agustín-Hernández, L., Vallespín Muniesa, A., Fernández-Morales, A. (eds.) EGA 2020. SSDI, vol. 5, pp. 630–640. Springer, Cham (2020). https://doi.org/10.1007/978-3-030-47979-4_54