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GIS-based Architectural Design in Heritage Landscapes: towards a Knowledge-based Definition of Touristic Routes

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GIS-based Architectural Design in Heritage Landscapes: towards a Knowledge-based Definition of Touristic Routes

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Abstract. Network-based spatial analysis tools are useful for solving complex routing problems. However, the search for the most optimal route in terms of distance and time does not always guarantee the most convenient design solution, as occurs in heritage landscapes. A landscape architecture project aimed at designing touristic routes that connect heritage resources requires additional variables as in these cases it is not only a matter of achieving the most efficient connection between the heritage assets, but of detecting the paths that allow a better interpretation of the cultural meaning of the landscape. This text presents a GIS-based analysis protocol that combines least-cost path network analysis with weighted overlay analysis in order to introduce the time depth, the visibility and the level of visual and noise pollution of the paths as variables of influence in the selection of the touristic routes. The proposed method has been applied in the metropolitan area of the city of Seville (Andalusia, Spain), where there are relevant heritage resources that remain unconnected and could benefit each other through integrative touristic formulas. The aim of the method is advancing a protocol for a computer aided advanced architectural design in territorial scales.

1. Introduction

The dominant ways of thinking and designing in architecture have substantially changed in the last decades, confirming the need of advancing novel formulas for achieving more scientific decisions. Bringing science into the design process without compromising the creativity is a mayor challenge in architectural research.

In the path towards an informed design, the access to geographic data during the design process has been acknowledged as helpful, especially when architectural design engages with territorial scales. Building a strong foundation of georeferenced data through Geographical Information Systems (GIS) extends our analytical capabilities and allows a better understanding of the territorial context we are dealing with, as well as of the impacts of our interventions on it [1]. The GIS has an inherent integration potential, as it is capable of functioning as both a tool and a language shared between different spheres of knowledge and agents [2]. For this reason, it allows the integration of multiple layers of territorial information as history, land use, hydrology, meteorology, topography, etc. in the design process.

This paper presents a GIS-based method for reaching scientific decisions in landscape architecture design. It particularly deals with the task of selecting paths for implementing a touristic project in a heritage landscape. Touristic routes, the object of this research, differ from cultural itineraries. The first ones are contemporary products created for touristic convenience [3][4], while cultural itineraries have been originated by historical processes that have turned them into paths with heritage value

[5][6]. While the identification of cultural itineraries responds to historical research, the definition of touristic routes requires analysis in terms of their potential both as networking and communication tools. They are specifically aimed at structuring the heritage offer of a cultural destination [7] as well at offering a clear reading of the cultural landscape they cross by equipping the walking experience with minor architectures that run along them and that facilitate the heritage interpretation process through viewpoints or scenic stops with interpretive panels, etc.

For this reason, it is not just about detecting the most efficient route between the heritage assets but of identifying the paths that allow a better interpretation of the cultural meaning of the landscape. This requires variables as time depth, visibility and visual/noise pollution to be considered. The trails which cross the landscape areas with the highest heritage value and that present fewer disturbing elements and wider viewsheds will allow a better appreciation and knowledge of the cultural landscape.

2. Materials and methods

The proposed route design method combines GIS least-cost path network analysis with weighted overlay analysis in order to introduce the time depth, the visibility and the level of visual and noise pollution of the paths as variables of influence in the selection of the touristic routes. The least-cost path analysis identifies the most optimal routes in terms of distance and time for connecting the heritage resources. The weighted overlay analysis starts by turning diverse base layers into value layers that distinct land areas according to different assigned levels, as described in table 1.

Table 1. Criteria and values for reclassifying the base layers

	Base layer	Criteria	Value
Time depth	Land use change map	Areas with the same land use since the first land use record	5
		Areas with minor land use change since the first land use record (e.g. change of type of cultivation in agricultural fields)	3
		Areas with mayor land use change since the first land use record (e.g. from agricultural use to industrial use)	0
Visibility	Viewsheds of the most relevant heritage items and cultural landscape features.	Areas where is possible to observe more than 10 heritage items or landscape features	5
		Areas where is possible to observe between 5-10 heritage items or landscape features	3
		Areas where is possible to observe less than 5 heritage items or landscape features	0
Noise pollution	Noise pollution map	No noise pollution recorded in the area	5
		55-60 dB(A)	3
		>60 dB(A)	0
Visual pollution	Visual pollution map witch identifies visual disturbing elements in the area	Areas out of the buffer zones of the disturbing elements	5
		Areas between 200 and 400 meters far from any disturbing element	3
		Areas less than 200 meters far from any disturbing element	0

The criteria have been designed according to the case study is meant to serve, but they can be modified to different densities of heritage items, landscape features and/or disturbing elements. Once all the base layers have been reclassified into the three defined values, a final layer of five levels of land suitability for touristic routes is obtained from a weighted sum that assigns 40% of influence for

time depth, 30% for visual pollution, 20% for visibility values, and 10% for noise pollution. The contrasted observation between the land suitability map and the optimal routes obtained by network analysis allows the designer to reach a final decision which balances time and distance effectiveness with scenic, landscape and heritage values. The described method is adjustable so it could evolve progressively by the addition of more variables and value ranges.

3. Results and discussion

The proposed method has been applied in the zone of the metropolitan area of the city of Seville (Andalusia, Spain) shown in figure 1, which is characterized by a high density of heritage resources. This area of approximately 100 km^2 covers a very wide temporal arc as it includes chalcolithic dolmens, the archaeological remains of El Carambolo, a protohistoric Phoenician temple, the archaeological remains of the Roman city of Italica, the monastery of San Isidoro del Campo (XIV century), the monastery of la Cartuja (XV-XVI centuries) and interesting vernacular architecture of modern and contemporary times like the hacienda de Torrijos or Divina Pastora. This heritage richness allows to trace the evolution of human settlement in the territory from the first occupations to the present with a complementary and differentiated approach from that offered by the city.

Figure 1. Case study area. Source: map by M López and photography by A Tejedor (2019)

However, these heritage items do not establish relationships each other or with the landscape and, consequently, the historical connections between them remain hidden from the population. It is a representative example of those periurban areas where the landscape diversity and the time depth of the territory coexist with fast roads, industrial areas or large commercial infrastructures that fragment the landscape and greatly hinder its heritage reading.

The methodology has been applied to this area using the software ArcGIS® y ArcMap™ 10.4.1. from Esri. It can be observed how the studied variables, as shown in figure 2, allow to reach a final route design more committed with the particular landscape values of the area.

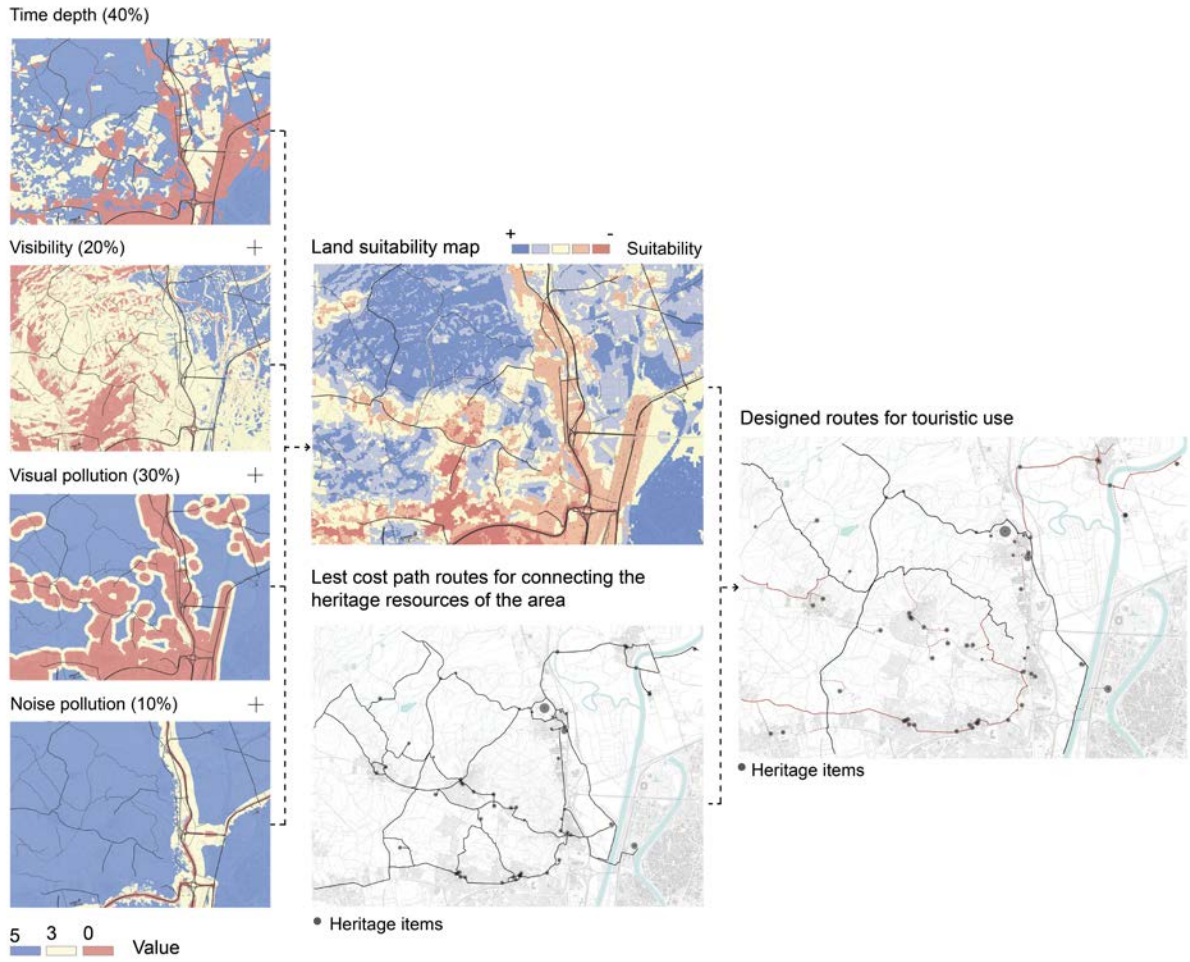

Figure 2. Results of the analysis. Source: M López

4. Conclusion

The sustainable development of our territories demands a greater relation between spatial planning and design with landscape and heritage [8]. In times of emergency such as the current one, the need to move forward into informed site-specific designs becomes vital. The described method combines a standardized quantitative formula, which is network analysis, with a weighted overlay system whose variables, criteria and weights can vary depending on the particular characteristics of the territory under study as well as the particular view of the designer. In periurban areas, measuring pollution levels or attending to land use change patterns becomes essential, but different contexts could need distinct parameters. The benefit of the method is to offer possibilities for re-thinking and adjustment, which are key for design-related contexts.

In the paths towards an informed architectural design, methods that are committed with the particular components and dynamics of a territory have to be developed. On the other hand, as architecture would never be a purely scientific discipline since creativity is equally attached to it as

technique, methods should also be capable of working as a stablished system with a fixed protocol that, however, allows adaptations to different views and progressive modifications through the design process.

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