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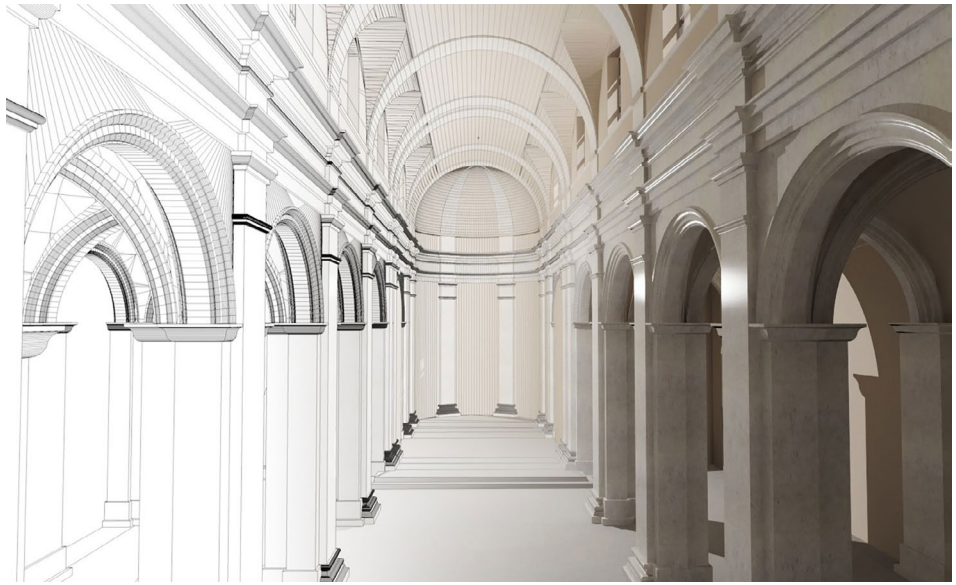

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UNIVERSITY OF L'AQUILA

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Knowledge of urban space through saliency maps and space syntax tools. Experimentation on historic center of Rieti

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The 60s of the last century were characterized by a great cultural ferment on the theme of urban space and its transformations resulting from conurbation. The political, social, economic, and environmental implications of this phenomenon were notable, to which we attempted to give both a cultural and scientific response. An important aspect concerned the need to govern urban and territorial transformations, guaranteeing the quality of urban space but, at the same time, safeguarding the memory of the historic centers which, precisely in those years, were undergoing the strong pressure of conurbation dynamics. One of the key studies is undoubtedly The Image of the City by Kevin Lynch from 1960 in which the author analyzes the role of environmental images in the perception of the city and its space. These studies are followed by other equally famous contributions (Cullen, 1961; Rossi, 1966; Norberg-Schulz, 1979) which, by exploring the mechanisms of the individual's perception of the environment, have given rise to a vast literature in the international field. Experiments in which the authors deal with urban reality, with its experience and the history of the traditional city in an attempt to develop codes to interpret and evaluate not only the characteristics of the physical city, but to look at urban spaces as spaces of relation.
Subsequent studies were started from the theories developed by Lynch and Cullen which define different methodologies for analyzing the urban landscape, to support the planning of new interventions and the transformation of pre-existing urban areas. Between the 70s and 80s, a group of researchers from University College London laid the foundations of what is now defined as spatial syntax, also known as configurational theory, applied to studies and analyses of urban space.

Keywords:
space syntax; configurational theory; evaluation maps; qualitative models; diachronic analysis.

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INTRODUCTION

The research and study of the mutual interrelationships between the individual and the environment has captured the interest of numerous disciplines (architecture, urban planning, sociology, geography, psychology, etc.) and, thanks to the possibilities offered by information technologies, are been carried out further developments and insights into what is now an interdisciplinary and multidimensional field of study. There are therefore various experiments in the analysis of urban space, aimed at defining models capable of reproducing perceptive processes, based on diversified methodological approaches depending on the specificities of the interdisciplinary groups.
Based on the results of the analyzes carried out, measurable indicators have been identified, referable to the environment, which allow us to reliably predict people's behaviors within the urban space. The research in question, specifically, experiments with ways of reading and analyzing the city relating to Spatial Syntax and Cognitive Sciences, which highlight some specificities of an environment through the calculation of numerical descriptors and estimate the possible or probable perception of a person and his behavior. Among the methodologies explored in depth in the literature, those deemed most suitable to describe the perception of urban space by an observer moving within it were chosen; it should also be highlighted that the information obtained is complementary to each other and, therefore, leads to the achievement of the most complete knowledge possible. (Fig. 1)
However, it is appropriate to make some methodological clarifications. The techniques proposed and applied to the case under study define a model that allows only part of the actual visual experience in an urban environment to be described; in fact, given their application with respect to representations of urban space on two-dimensional planes (floor plans, in the case of isovists or photographic images for saliency maps), they analyze information that concerns only some physical properties of the real world. In particular, within Space Syntax the isovist calculation, performed on the basis of urban environment plans, neglects the third dimension and the dynamic component, specific to the exploration of the urban environment. Despite the abstract nature of the spatial representations underlying the isovist calculation, it is possible to collect useful information for the construction of a reliable and useful account for reading urban space. In the field of Cognitive Sciences, the development of saliency maps is based on biologically plausible computational models, capable of reproducing a form of bottom-up focal attention which is based mainly on external stimuli and their perceptual characteristics. It is, therefore, a processing mode guided by sensory data. Top down processing, on the other hand, is based on cognitive processes that involve attention and memory and is therefore guided by the concepts and representations contained in each individual's memory, which are therefore extremely difficult to reproduce as they are linked to personal experience. Perception is linked both to the processing of signals coming from the sense organs and to other cognitive functions such as attention, memory and imagination. Numerous investigation procedures have been developed and tested which, through the analysis of visual experience, allow the extrapolation of numerical data capable of describing the phenomena linked to perception, through a quantitative description of the bottom-up processing processes; the latter are easier to study and reproduce; in fact, they are not linked to internal states of the observer such as attention and memory. In conclusion, these models, applied to images of urban contexts, allow us to analyze a scene by trying to partially reconstruct the mental process that defines it, to identify which components could construct the mental image of a city.

INSTRUMENTS AND METHODS FOR URBAN SPACE KNOWLEDGE

The city is closely linked and participates, as a supporting structure, in the multiple manifestations of civilization; this assumption shows the breadth and variety of the urban phenomenon and expands the field of exploration, requiring the participation and contribution of disciplines that fall within other fields of knowledge, in order to develop reading models that allow us to investigate and represent the complex relationships that link the shape of cities and individuals, as "We shape cities and cities shape us" (Gehl, 2010).
In the preface to Jan Gehl's text Richard Rogers writes: "Cities, like books, can be read [...]. The streets, paths, squares and parks are the grammar of the city; they define the structure that allows cities to come to life and to encourage and accommodate diverse activities, from the quiet and contemplative to the noisy and crowded.

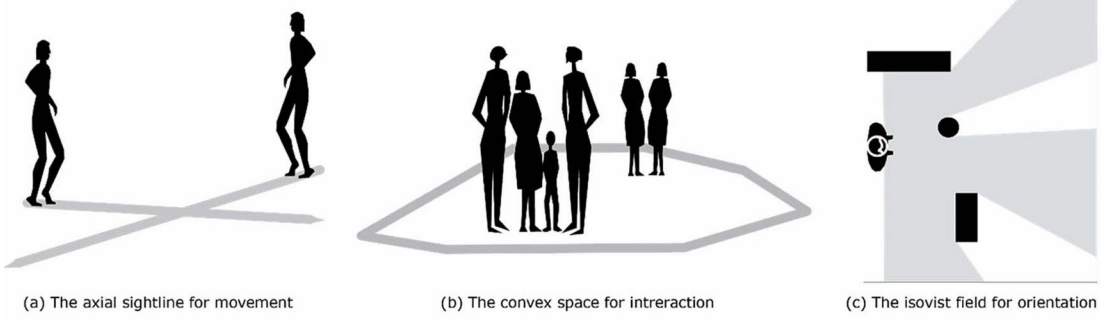

Fig. 1 - The elementary spatial units that are used in space syntax. https://www.mdpi.com/2071-1050/13/6/3394

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A humane city - with carefully designed streets, squares and parks - creates pleasure for visitors and passers-by, as well as those who live, work and play there every day. [...] Well-designed neighborhoods inspire the people who live in them, while poorly designed cities brutalize their citizens." [...] public spaces and civil society are inextricably intertwined." (Gehl, 2010).
The modern movement had defined an operational method, based on standardized and objective typological schemes, to be applied in an urban environment divided into distinct functional areas; this system involved the sizing of streets, squares and housing through the application of standardized parameters, without any relationship with the forms of the historic city.
These operational tools soon proved inadequate and incapable of responding to the problems associated with post-war reconstruction. The inability of this approach to intervene on consolidated fabrics is contrasted by a trend, led by Aldo Rossi, which opens the way to a new way of understanding the project in relation to the recovery of historic centers with new interventions. Moreover, the sixties and seventies of the last century were a period of great vitality for the study of cities, characterized by a flourishing of research which, by exploring the mechanisms of the individual's perception of the environment, gave rise to a vast literature in the international field.
Experiments in which the authors deal with urban reality, with its experience and the history of the traditional city in an attempt to develop codes to interpret and evaluate not only the characteristics of the physical city, but to look at urban spaces as spaces of relation. "Living (walking, shopping, parking, etc.) is first and foremost a cognitive or semiotic performance, it requires deciphering the urban text in search of signs of danger, possibility, prohibition, permission, enjoyment, convenience, etc. This skill is first and foremost morphological, it consists in recognizing shapes and giving them a meaning connected to everyday practices" (Ugo Volli, Laboratorio di semiotica, Roma - Bari, 2005).
Kevin Lynch (Lynch, 1960) and Gordon Cullen (Cullen, 1961) are undoubtedly the precursors of a new way of "seeing" and "understanding" urban space. (Fig. 2)

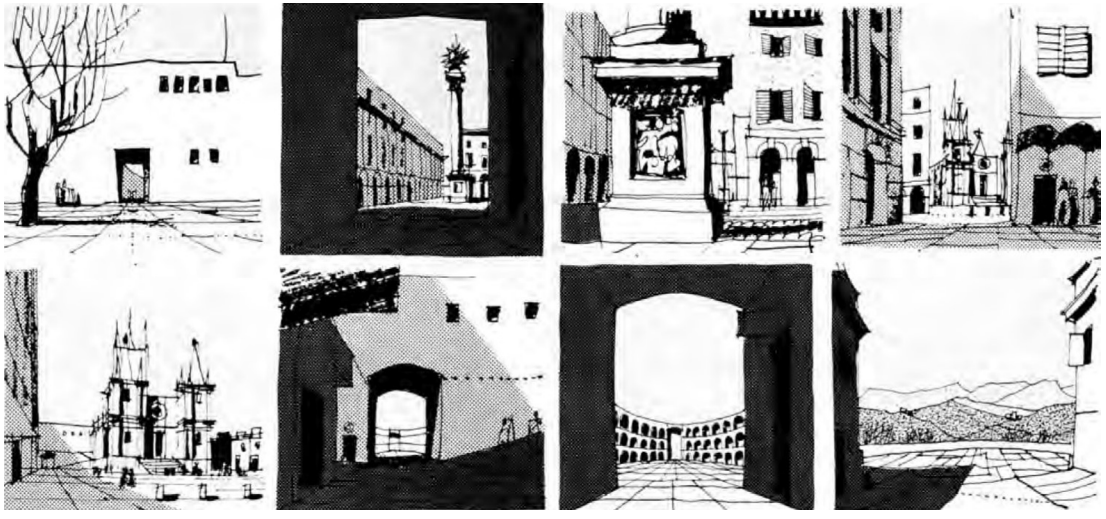

Fig. 2 - "Serial vision", from Townscape, Gordon Cullen (1961)

From their theoretical approach, subsequent studies are initiated which define different methodologies for analyzing the urban landscape, useful support tools and guidance for the planning of new interventions. In particular, in the Seventies and Eighties, Spatial Syntax, also defined as configurational theory, was born from the experiments of a group of researchers at University College London; today these theories are applied to studies and analyzes of urban space to identify the relationships between city planning and the way in which they function from an economic, social and cultural point of view.
This contribution describes the first results of an experiment based on those techniques for reading and analyzing the urban landscape relating to Spatial Syntax considered most suitable for describing the perception of urban space by an observer who moves within it.
The first is that of the isovist whose term, coined by Clifford Tandy in 1967, applied to the study of the natural landscape, was later introduced into the analysis of the built environment by Benedikt.
The isovist is therefore "the set of all points visible from a given point of view in space and with respect to an environment". Although the expression "set of points" intrinsically refers to a three-dimensional environment (Dalton, 2015) , Benedikt himself brought this together with its planar equivalent, in order to capture experiential aspects of space (Wiener et al. 2007). "The appeal of isovists is due to the fact that they provide a description of space from the inside, from the point of view of individuals, how they perceive it, interact with it and move through it" (Turner, 2001).
The analysis of urban space, following Benedikt's experiments, can be carried out through isovists and through the subsequent calculation of derived quantities, i.e. numerical descriptors, useful for estimating the perception of the environment from within the space itself.
The application of basic mathematical operations, in fact, allows us to obtain a large number of quantities from the isovist and obtain a description relating to the geometric and configurational properties of the environment being analyzed. (Fig. 3)

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The isovist analysis, as mentioned, has been the subject of criticism. In addition to that relating to the third dimension, refuted by Dalton (N. Dalton et al, 2015), a further criticism concerns the lack of the dynamic component that characterizes space exploration. In this sense, the isovist sequences, referred to by Turner, are useful, as they allow us to describe the environment perceived by an individual moving in space and at the same time to reproduce the dynamic participation that characterizes the exploration of the environment (Turner , 2001). This latter approach was already suggested by Thiel in 1970 "Since the experience of space involves movement, space is more dynamic than static and is more appropriately described by a succession of changing visual fields" (referring to the different positions that can be occupied by walking through the built space). The isovist sequences evidently refer to Cullen's serial visions, in fact, the observer, moving through the urban space, continually changes his position, therefore his point of view and the portion of visible space; therefore, a persistent variation in the shape and size of the isovists is determined; the higher the overlap of the same, relating to different strategic points, the easier it is for people to orient themselves.

A further step forward in the two-dimensional isovist analysis was the transition to the isovist field, which consists of a graphic representation of the values obtained by calculating the isovist generated at the vertices of a grid superimposed on the space being analyzed. "To the extent that visual fields represent potential experience, philosophically one could say the "idealist" vision of reality is the union of all possible experiences" (Benedikt 1979). Isovist fields offer an objective and unique description of an environment (Morello & Ratti, 2009).

Benedikt suggests how the rate of change of the isovist field can be useful in the study of perception and behavior, referring to Gibson's environmental psychology and his concept of optical flow that can guide an individual through a landscape.

The state of the art also includes research relating to other disciplinary fields, thanks to which analysis systems have been developed that are effectively applied to the interpretation of urban space. Among these, in the field of Neuroscience, reference is made to models that allow us to analyze an urban scene by trying to reconstruct, at least partially, with biologically plausible computational models, the neuronal mechanisms of attention control. Human beings acquire information about the external environment mainly through vision, therefore, the visual exposure of urban space affects the quality, perceived well-being and behaviors of individuals. Developing computational models that describe how attention is distributed within a given visual scene has been a major challenge for neuroscientists. This has led to the research and experimentation of automatic systems capable of reproducing a form of bottom-up focal attention based on salience. The principles underlying the neuronal mechanisms of attention control studied for the first time by Koch and Ullman in 1985 were reproduced by Itti and Koch by means of a model centered on "salience maps", i.e. explicit two-dimensional topographic maps that encode the stimulus visibility, or relevance, at every point in the scene, reproduced by an image. (Fig. 4)

In the development of models that simulate bottom-up processes, therefore, the functioning of neurons is reproduced which, in the early stages, are tuned to simple visual attributes such as in-

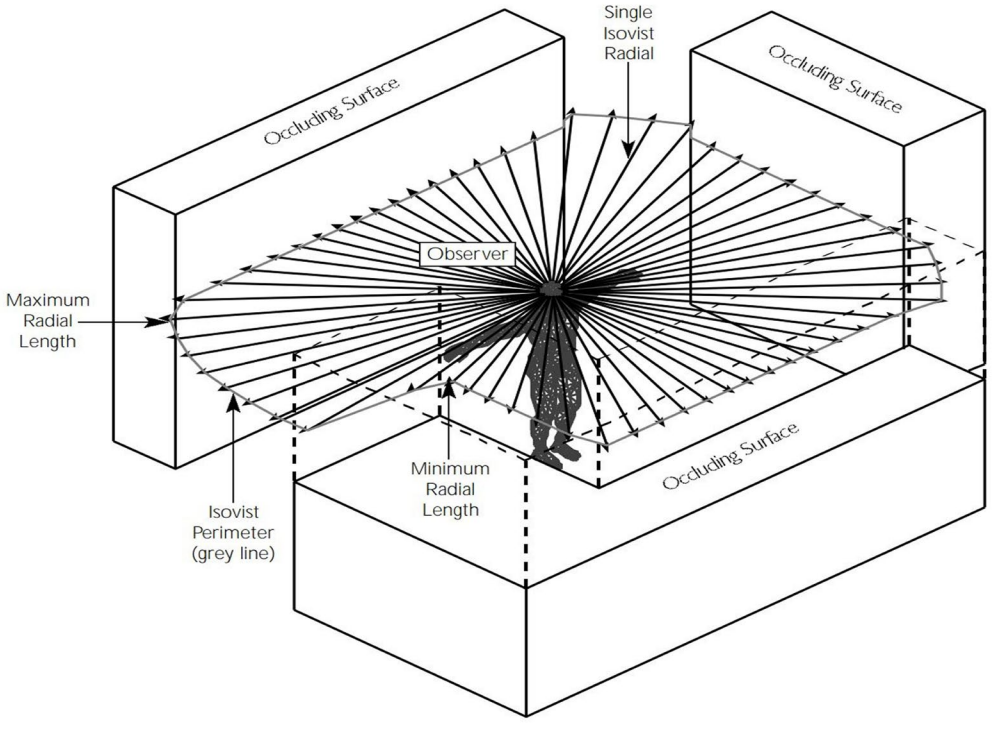

Fig. 3 - Isovist symbolic representation, Ruth Conroy (2001). The observer is comparable to a visual sensor. Corresponding isovist is the set of all points visible from his given viewpoint punctual position in space with respect to an environment (that is taking surrounding occluding surfaces into account).

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tensity-contrast, color (for pairs of opposites) and orientation. The identification of salient objects occurs very quickly and is driven primarily by bottom-up processes, although it can be influenced by contextual effects. Furthermore, attention is involved in the activation of behavior, and is consequently intimately linked to recognition, planning and motor control.
Various research has demonstrated the computational utility and plausibility of saliency maps, which describe how attention is distributed within a given visual scene and consequently provide the tools to successfully predict the behavior of humans and monkeys in tasks of research; these studies, therefore, address the relationship between perception, cognition and action. "The saliency map is a normalized representation that offers a measure of selective attention by indicating the priority of visual stimuli in a reproduced real scene." (C. Verdoscia, F. P. De Mattia, A. C. Maiorano, M. Di Puppo, R. Tavolare, Il modello percettivo dell'immagine urbana, Proceedings of the UID conference "Disegno e città", Torino 2015 pp. da 863 a 870).
These models, applied to images of urban contexts, therefore allow us to analyze an urban scene by trying to partially reconstruct the mental process that defines it, to identify which components could construct the mental image of a city.

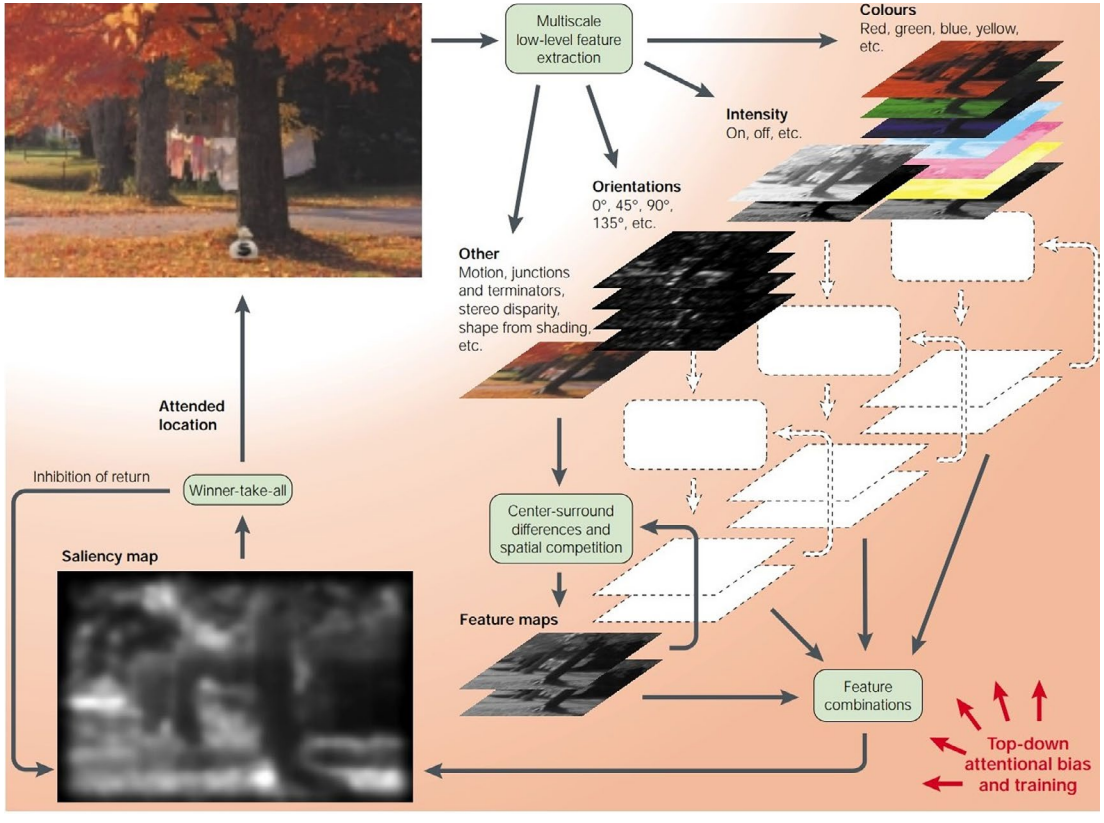

Fig. 4 - A Block Diagram of Human Visual Attention Processing in the form of a Saliency Map. http://ilab.usc.edu/publications/doc/Itti_Koch01nrn.pdf
Itti, Laurent, and Christof Koch. "Computational modelling of visual attention." Nature reviews neuroscience 2.3 (2001): 194-203.

SALIENCY MAPS AND SPACE SYNTAX TOOLS

The choice of the analysis methods to be tested was guided by the characteristics of the places chosen as case studies, for which it was decided to calculate the isovist field in correspondence with the squares and open urban spaces that induce the visitor to stop, while the 'isovist along the route appears more suitable for describing the visual peculiarities of narrow streets surrounded by buildings, through the analysis of the trend of the quantities derived along the route.
Currently the Toolbox used for the isovist calculation, under development, essentially takes into account the information relating to the building volumes that shape the urban space, while other data, relating for example to the size of advertising billboards, lighting fixtures or trees are not considered. In order to integrate the missing information, it was decided to combine the isovist analysis with the development of saliency maps.
In recent decades, also thanks to the ever-increasing calculation capabilities offered by IT tools, various software and toolboxes have been developed that allow calculating isovist in an urban environment and obtaining some derived quantities, obtaining a useful description, in visual terms, of the space same. For the research in question, the Grasshopper Toolbox, DeCoding-Space, was used, which allows 2D and 3D isovists to be calculated using the Rhinoceros 7 software; it is a free application developed and released by the Computational Planning Group (CPlan) in 2019 and is the result of long-term collaboration between academic institutions and technical partners from all over the world, aimed at increasing efficiency and quality of architecture and urban

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planning. In particular, the Bauhaus Weimar University, Chair of Computer Science in Architecture and Chair Computational Architecture, are institutional members of the Computational Planning Group (CPlan); ETH Zürich, Chair of Information Architecture; 3Emerging City Lab, Addis Ababa; Future Cities Lab Singapore; Austrian Institute of Technology Vienna and DecodingSpaces GbR.
To process the saliency maps, the algorithm was developed by Itti and Koch and replicated by the Mathlab Toolbox, Visual Saliency, whose definition is described in the contribution "Computational modeling of visual attention", written by L. Itti and C. Koch, published in Nature Reviews Neuroscience, volume 2, in 2001. Subsequently Jonathan Harel, Christof Koch, Pietro Perona of the California Institute of Technology, in 2006, developed another algorithm, Graph-Based Visual Saliency (GBVS); it is a model which, by also reconstructing bottom up processes, presents a higher level of predictivity than previous Itti Koch algorithms (98% versus 84%). The model is able to predict the areas of a scene on which the human eye will focus its attention.
The inputs necessary to carry out the aforementioned analyzes are on the one hand planimetric processes for the isovist calculation, on the other hand photographic images of the urban environment, processed through the application of specific algorithms, to obtain saliency maps.

EXPERIMENTATION ON HISTORIC CENTER OF RIETI

The methods codified within the spatial syntax have been tested in various urban contexts, more or less historicized and also in the archaeological field, with the aim of identifying the spatial structure of the built environment and deepening the knowledge of the social organization of the city (Stöger , 2011). In recent years, numerous studies and research have been conducted aimed at identifying any existing relationships between quantities derived from isovist and perception of space, with the aim of tracing a series of spatial factors to their psychological analogues. In particular, Franz & Wiener (2008) demonstrated the existence of a correlation relationship between area, compactness and occlusiveness and the way in which people, subjected to a test, evaluated, respectively, perceived beauty, complexity and spaciousness of a configuration.The isovist drift, however, was found to be related to visual stress (Leduc & Kontovourkis, 2012). Finally, there is a correlation between the average radius and openness of the space under study and the ability to orient oneself in it (Weitkamp, 2010). These techniques, therefore, allow us to describe not only the morphological properties of the built environment, but through the identification of correlation relationships, to predict the behavior of people in visible urban space. As part of the different analysis methodologies specific to spatial syntax and on the basis of the aforementioned studies, in this study it was intended to apply two reading and analysis techniques, that of isovists and that of saliency maps, to a part of the historic center of Rieti considered exemplary of the historical, morphological, monumental and urban fabric characteristics. The stretch is the one that starting from the Porta Cintia, one of the main gates that characterize the Rieti city walls which remained intact for many stretches, follows the route of the cardo and the decumanus of the Roman era and which intersects with the other stretch, that of via Roma, in correspondence with the central square of Rieti, the ancient forum, Piazza Vittorio Emanuele II. (Fig. 5)
This trait is, as mentioned, particularly representative and diversified in its own way.
The interest in this and other important junctions of the city (entrances, bridges, squares) arose as part of the activities promoted by the DTC Lazio and the "RitrovaRieti" research project which aims to retrace the urban transformations of a non-functioning place only of formal and architectural aspects but, above all, social and cultural ones.
Porta Cintia, a historicized passage element between the urbanized and non-urbanized environment, also becomes in this study the opportuni-

Fig. 5 - From above: external view of the walls and the two modern buildings that mark the entrance to the historic city where the ancient Porta Cintia stood; Arch of the Bishopric, nodal point along the Roman decumanus; Vittorio Emanuele II Square

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ty for further experimentation with a diachronic approach, with reference to three fundamental moments that have strongly modified the urban structure , and therefore perceptive, of this place: the demolition in 1859 of the Porta Cintia set in the long stretch of medieval walls; in its place, the construction in 1870 of a barrier to control goods entering the city center with crenellated towers and pincer walls; the decommissioning of the Barrier following war-related damage and the construction in 1952 of two buildings in rationalist style with passage porticoes on the ground floor (Paris & Rossi, 2023). The 2D planimetric configuration of each of these time instants was used to calculate the isovist field, described by color gradient maps relating to the derived quantities Area, Compactness, Occlusivity, Mean Radius and Drift. With these quantities, some studies, as mentioned, correlate sensorial and perceptive reactions concerning, in order, Beauty, Complexity, Spaciousness, Orientation and Visual Stress (*Franz, G., Wiener, J. M., 2008; T. Leduc, O Kontovorkis, 2012). The diachronic analysis regarding the size Area, associated with the sensation of Beauty, returned maximum and constant values along the entire external path of the walls (but only at a certain distance) with a significant reduction near the door with a strong contrast in the case of the Barrier, more attenuated in the current state of the rationalist era. The Compactness analysis instead describes a significant reduction in the degree of Complexity on the outside of the walls near the door in the current state compared to the two previous phases. In a similar way, the evaluation maps based on the correspondence of the isovist derived quantities can be read and interpreted.
To process the saliency maps, obviously not having photographic images of the medieval state, the Graph-Based Visual Saliency (GBVS) algorithm was applied on photographic images of the Wall and the current state (on the right of figure 6). This was then also tested on frontal perspective views of the three-dimensional reconstructive models of the three temporal configurations (on the left of figure 6).
The analysis conducted on 2D views derived from

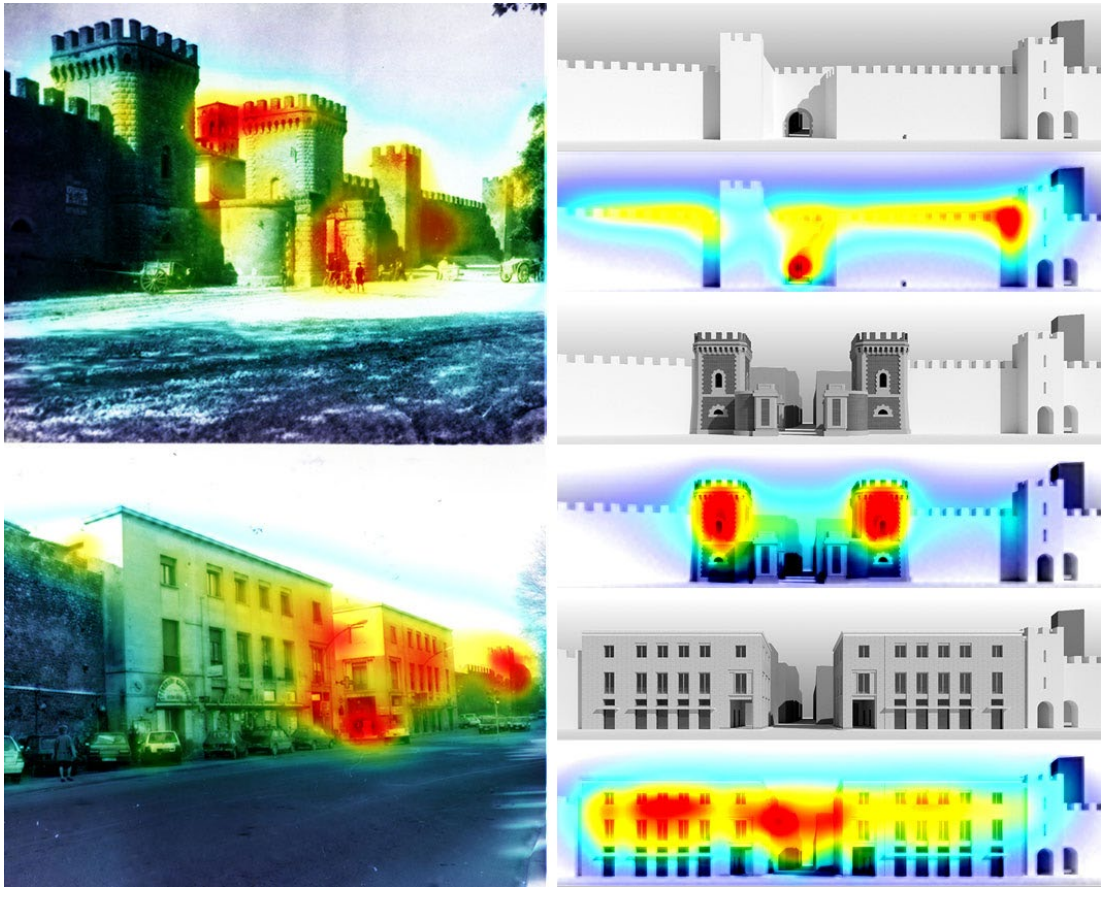

Fig. 6 - Saliency maps developed on historical archive photos (on the left) of the Barrier and modern buildings with lateral grip point, and on frontal views of the three-dimensional models (on the right) for simulating the various temporal scenarios.

3D models allowed greater control of the process and greater reliability of the results compared to that carried out on photographic images as they lack attractive elements (for example people) and share the same point of view, same quality and resolution, same lighting as the digital scene. The comparative diachronic analysis highlights the strong perceptive variability of the two conformations (nineteenth century and today) with the same lateral view. Equally significant and original, as the first experimental result, is the comparative diachronic analysis of the front view of the door in the three periods examined.
The methods applied to the Porta Cintia area were also tested on the first stretch of historical road network, that of via Cintia up to Piazza Vittorio

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Fig. 7 - Maximum and minimum values of the derived isovist dimensions long the chosen path

Emanuele II. In this case the object of study is the one corresponding to its current conformation. In particular, the isovists were calculated along the route and the diagrams describing the trend of the derived quantities along the chosen route were critically read. For the isovist calculation we based ourselves on the Regional Technical Map in 1.5000 scale in order to obtain an indispensable planimetric model to perform the calculation of the 2D isovist. The maximum radial length was set at 200 meters and the width of the visual angle at 90°.
Fig.7 shows the graphs relating to Area, Compactness, Occlusiveness, Average radius and Drift, i.e. those among the derived quantities which, as mentioned, present correlation relationships with some perceptive indicators. The reflections of the present study mainly concerned the trend of Occlusivity, Average Radius and Drift and therefore of the perceptive indicators correlated to them. The considerations relating to the trend of the Area were omitted, as they can be deduced even without the calculation of the isovist, while it was decided not to analyze the trend of the Compactness correlated to the perception of Complexity, as the latter is a indicator that cannot be considered unique; in fact, Complexity is considered as a positive quality in Western culture countries such as England (J. Cooper, D. Watkinson, R. Oskroch, 2010), while a subjective survey submitted to an audience of Taiwanese origin revealed how it be understood negatively (J. Cooper, Mei-lin Su R. Oskrochi, 2013).
The graph relating to the trend of the average radius highlights a constant oscillation between high and low values until reaching a minimum peak in correspondence with a curve, in the route of via Cintia, which connects two mutually perpendicular directions and a maximum value in correspondence with the entrance to Piazza Vittorio Emanuele II; it is therefore possible to predict that a person moving along this path will experience difficulty in orienting themselves near the curve. A circumstance which is confirmed in the phrase of Ruth Conroy Dalton, who comments with these words on the results of her experiments "people tend to conserve linearity through their routes with minimal angle deviation" (Conroy Dalton 2003, p. 125).

Fig. 8 - Trend of the dimensions derived with respect to four positions identified in the squares under study by setting a 2x2 m grid, maximum radial length set at 100 meters and 360° visual angle

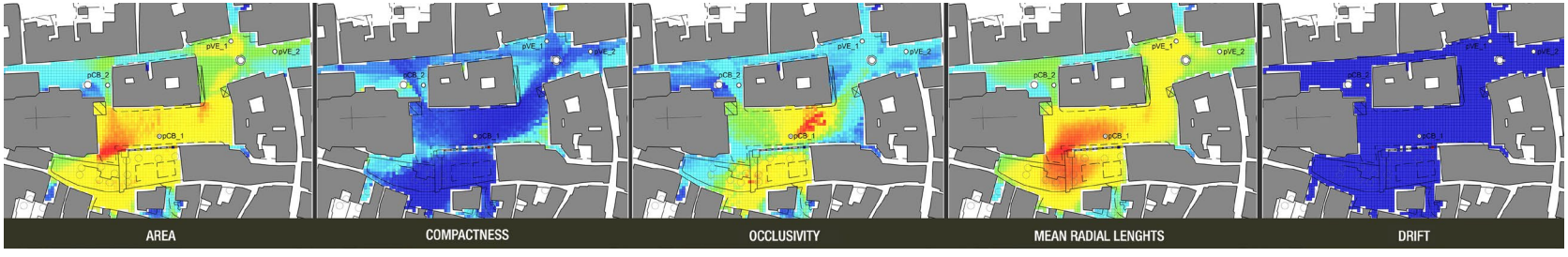

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Fig. 9 - Extracted from the sequence of 33 photos. NN. 5, 11, 15, 18, 23, 26, 29, 32

The graph relating to isovist drift shows higher values in correspondence with road sections characterized by particularly small sections, this implies greater visual stress on the part of an observer moving in urban space.
The observation of the trend of Occlusivity reveals values that decrease constantly until reaching a minimum peak near the curve, this area will therefore not be perceived as spacious, a perception of spaciousness that will grow rapidly as the path progresses straight line.
Regarding the squares under study, it was decided to calculate the Isovist field, with respect to some positions, by setting a 2x2 m grid, maximum radial length set at 100 meters and visual angle at 360°. The isovist field is described by maps with color gradients that illustrate the trend of the derived quantities (A - C - O - MR - D) in an area, set before starting the calculation, around the indicated position. (Fig. 8)
To proceed with the development of saliency maps, through the Mathlab software, photographic images relating to the route of via Cintia extracted from Google Street View were acquired; this method of acquiring views of the urban environment has been the subject of several studies and experiments (Waishan Qiu et al, 2021 and 2022; Luyao Xiang et al, 2021; Ian Seiferling et al, 2017).
The Google Street View application, through the use of the Application Programming Interface (API), allows the user to acquire images of the street environment by setting some properties

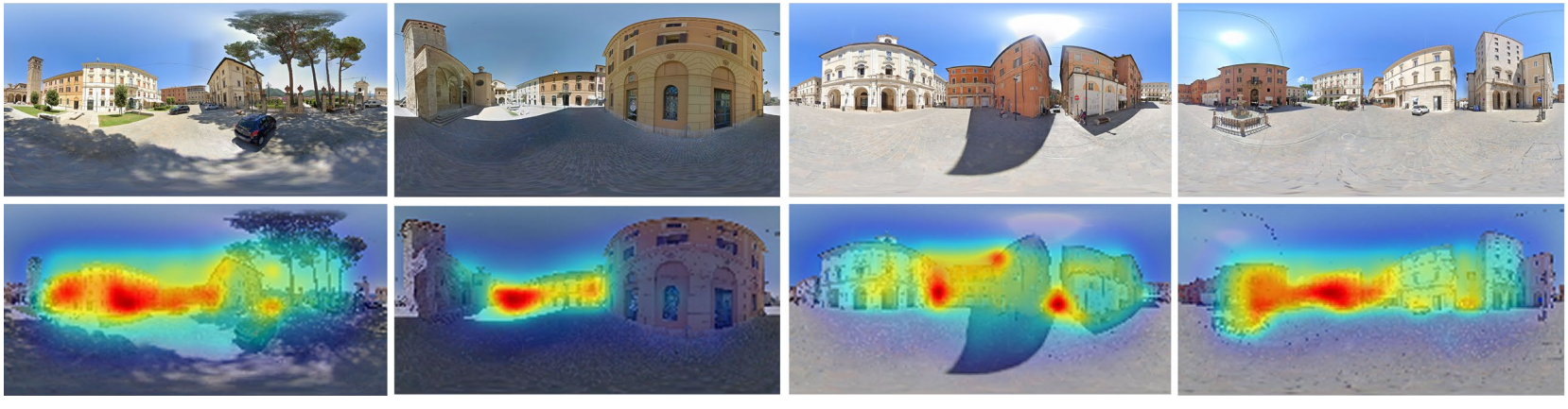

Fig. 10 - Saliency maps for the squares under study taken from equirectangular photographic images from Google Street View, from the same positions with respect to which the isovist fields were calculated.

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relating to the camera. Each digital photograph (in jpeg format, RGB color channel) was acquired through the GSV API, setting some parameters.
For the route of via Cintia, 33 images (400x300 pixels) were extracted, in succession with a step corresponding to that of Street View. (Fig. 9)
For the squares under study, however, saliency maps were developed from equirectangular photographic images also extracted from Google Street View, from the same positions with respect to which the isovist fields were calculated. (Fig. 10)

CONCLUSIONS

Even if the experimentation only involved an urban context of modest extension, it is also possible to draw some considerations in anticipation of a possible extension to larger and more significant parts of the historic center of Rieti for the development of evaluation maps capable of highlighting, both from a synchronic but also diachronic point of view, the not only quantitative but also qualitative impact of the transformations which, in several places, have affected the historic center of Rieti in the last century and a half.
The evaluation maps can therefore represent a valid aid for designers and local administrators in identifying possible critical issues and in the consequent planning of suitable and effective interventions to enhance and safeguard the historic center in its broadest sense of not only material cultural heritage but also and above all immaterial.

NOTE

[1] Visible area, area generated by the isovist polygon, i.e. the total sum of all visible points (on a horizontal plane). Unit of measurement square meter.
Completeness, ratio of area to perimeter, the most efficient area/perimeter ratio is produced by a perfect circle. Unit of measurement meter.
Occlusivity, sum of the measurements in meters of the contours of the isovists not made up of occluding walls. Unit of measurement meter.
Average radial length, average across the lengths of all rays (one for each degree). Unit of measurement meter
Drift, distance in meters between the point where the isovist is generated and the center of gravity of the isovist. This measure can only take positive values. The drift will tend towards a minimum value at the center of the spaces and along the center lines of the streets. Unit of measurement meter.

REFERENCES

Benedikt, M. L. (1979). To take hold of space: isovists and isovist fields. *Environment and Planning B*, 6(1), 47-65.

Conroy, R. (2001). *Spatial navigation in immersive virtual environments*, University of London, 127-132, 153-160.

Conroy Dalton, R. (2003). The secret is to follow your nose. Route Path Selection and Angularity, *Environment and behavior, 35(1)*, 107-131.

Cooper, J., Oskrochi R. (2008). Fractal analysis of street vistas: a potential tool for assessing levels of visual variety in everyday street scenes, in *Environment and Planning B: Planning and Design, 35*, 349-363.

Cooper, J., Oskrochi R., Watkinson, D. (2010). Fractal analysis and perception of visual quality in everyday street vistas, *Environment and Planning B: Planning and Design, 37*, 808-822.

Cooper, J., Su M. L., Oskrochi R. (2013). The influence of fractal dimension and vegetation on the perceptions of streetscape quality in Taipei: with comparative comments made in relation to two British case studies, *Environment and Planning B: Planning and Design, 40*, 43-62.

Cullen, G. (1961). *Townscape*, Architectural Press, New York.

Cutini, V. (2010). *La rivincita dello spazio urbano. L'approccio configurazionale allo studio e all'analisi dei centri abitati*, Plus, Pisa.

Dalton, N. S., Dalton, R. C., Marsala, P., Peverett, I., Clinch, S. (2015). *Three dimensional Isovists for the Study of Public Displays*, 10th Space Syntax Symposium, London.

Franz, G., Wiener, J. M. (2008). From space syntax to space semantics: a behaviorally and perceptually oriented methodology for the efficient description of the geometry and topology of environments. *Environment and Planning B Planning and Design, 35(4)*, 574-592.

Harel, J., Koch, C., Perona, P. (2006). *Graph-Based Visual Saliency*, California Institute of Technology.

Hillier, B., Hanson, J. (1984). *The Social Logic of Space*, Cambridge University Press, London.

Itti, L., Kock, C. (2001). Computational modeling of visual attention, *Nature Reviews Neuroscience, 2*, 194-203.

Koch, C., Ullman, S. (1985). Shift in selective visual attention: Towards the underlying natural circuitry, *Human Neurobiol, 4*, 219-227.

Leduc, T., Miguet, F., Tourre, V. (2017). Motion Perspectives Integration in the Qualification of the Urban Spaces: Towards a 2D- and a 3D-Enrichment of the S-Partition Method. *Urban Design and Representation*, 69-82.

Leduc, T., Kontovourkis, O. (2012) Towards a mixed approach combining visibility and mobility studies to analyze the Eleftheria Square, Nicosia (CY), *COST Action TU0801 - 3D Issues in Urban and Environmental Systems*, Società Editrice Esculapio, 67-77.

Lynch, K. (1960). *L'immagine della città*, Marsilio, Venezia.

Nasar, J. L. (1997). *The evaluative image of city*, Londra.

Nijhuis Ronvan, S., Van Lammeren, R., Van der Hoeven, F. (2011). *Exploring the visual landscape. Advances in Physiognomic Landscape Research in the Netherlands*, IOS Press, Olanda.

Norberg-Shulz, C. (1979). *Genius Loci. Paesaggio Ambiente Architettura*, Electa, Milano.

Paris, L., Rossi, M. L. (2023). La conoscenza delle trasformazioni urbane per la salvaguardia e valorizzazione dei centri storici. Il caso di Porta Cintia a Rieti. *Disegnare Idee Immagini, 64*, Gangemi Editore, 50-61.

Rossi, A. (1966). *L'Architettura della città*, Città Studi Edizioni, Milano.

Stöger, H. (2011). Rethinking Ostia: a spatial enquiry into the urban society of Rome's imperial port-town, Doctoral Thesis in *Archaeological Studies Leiden University, 24*, Leiden University Press, Amsterdam.

Turner, A., Doxa, M., O'Sullivan, D., Penn, A. (2001). From Isovist to Visibility Graphs: A Methodology for the Analysis of Architectural Space. *Enviromental and Planning B Planning and Design, 28(1)*, 103-121.

Van Nes, A., Yamu, C. (2021). *Introduction to Space Syntax in Urban Studies*, Springer, Cham, Switzerland.

Verdoscia, C., De Mattia, F. P., Maiorano, C., Di Puppo, M., Tavolare, R. (2015). Il modello percettivo dell'immagine urbana, *Disegno&Città. Cultura Scienza Arte Informazione*, 863-870.

Weitkamp, G. (2010). *Capturing the view: a GIS based procedure to assess perceived landscape openness.* Wageningen University, The Nederland.

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