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Applying a Digital Approach for Detecting Potential Crime Hot Spots in Urban Planning Designs. Case study: New Urban Pole "Mohammed Issami", Biskra, Algeria

تطبيق مقاربة رقمية للكشف عن النقاط الساخنة للجريمة المحتملة في تصاميم التخطيط الحضري

حالة: القطب الحضري الجديد "محمد عصامي"، بسكرة، الجزائر

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Abstract:

In this study, we follow the visibility approach that was developed by the Laboratory of Space Syntax, UCL (University College London). This approach provided a sense of the link between the space design and its positive or negative social consequences in the future. After analyzing a central urban neighborhood of the New Urban Pole of Biskra "Mohammed Issami", basing on Depthmap, we found 33 hot spots that can be considered appropriate spaces for exercising crime in the future. We also found that this type of advance evaluation was not considered in the urban planning designs before the execution.

Keywords: Urban Extensions; Crime; Biskra; Hot Spots; Depthmap.

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ملخص:

في هذه الدراسة، اتبعنا المقاربة البصرية المطورة من طرف مخبر التركيب المجالي للكلية الجامعية بلندن. تعطي هذه المقاربة معنا للصلة بين تصميم الفضاء وعواقبه الاجتماعية الإيجابية منها أو السلبية في المستقبل. واستنادًا على خريطة الرؤية (Depthmap) قمنا بتحليل المجاورة السكنية المركزية للقطب الحضري الجديد في بسكرة "محمد عصامي"، فوجدنا 33 نقطة ساخنة يمكن اعتبارها أماكن مناسبة وجاذبة لممارسة الجريمة في المستقبل. كما وجدنا أيضًا أن هذا النوع من التقييم المسبق لم يتم أخذه بعين الاعتبار في تصاميم التخطيط الحضري قبل التنفيذ.

الكلمات المفتاحية: الامتدادات الحضرية – الجريمة – بسكرة – النقاط الساخنة – خريطة الرؤية.

Introduction

The human urbanisation has experienced frequent development through time and space, where a number of factors have played different roles according to their effects and balances in describing their orientations, types, and forms. The human urbanisations developed various structural patterns, such as small or large, compact or spaced, remaining or renewed, fixed or moving, etc. The imposition of human action, logic, and thought in the area that surrounds it developed many architectural images that certainly express the social relations and interactions in a certain context. The images of different urban products in different parts of the world clearly reflect structural differences. These implicit differences clearly indicate positive or negative human behaviours.

Recently, the concept of urban planning has attracted great scientific response in meeting human needs in space and the urban sphere. However, many urban formations have left serious repercussions and intensified the problems that the planner and designer did not notice or predicted ahead of time or need. The negative urban spaces resulting from poor urban planning of new urban extensions or new cities are among the most important problems that are discussed in this study. These negative spaces promote negative human behaviours such as criminality. Moreover, it is observed that the supposed outlet of the mother city of Biskra, i.e., the New West Urban Extension of Biskra, for example, suffers from this problem.

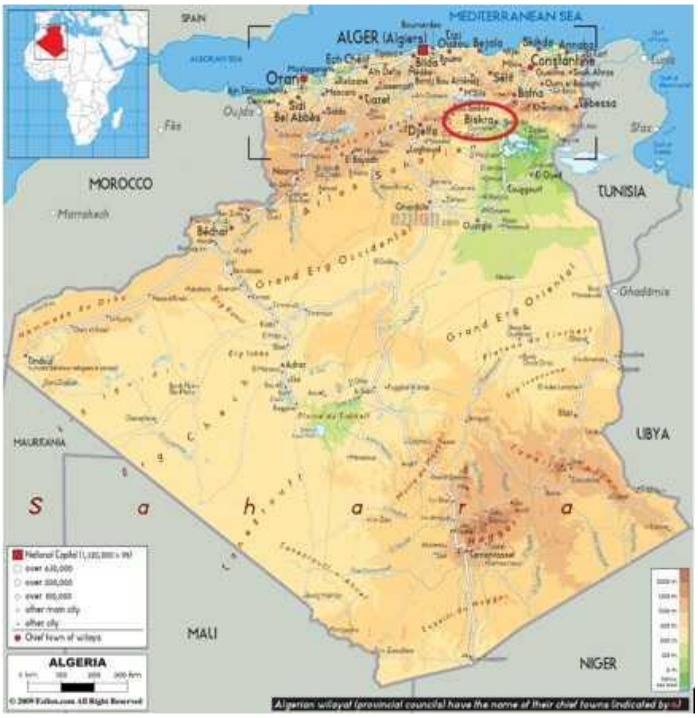
Presentation of the case study of "Biskra city"

Biskra city is located in the southeastern part of Algeria, i.e., at the base of the mountain range of the Saharan Atlas. The city of Biskra covers an area of 127.70 km2, surrounded in the north by the Municipality of Lotaya, in the south by the Omash Municipality, in the east by the Sidi Okba Municipality and the Municipality of Shatma, and in the west by the Al-Hadjeb Municipality. The Municipality of Biskra is located at a latitude of 34°51′01″N and a longitude of 5°43′40″ (elevation above sea level is 115 m = 377 ft). Moreover, it is observed that its semi-continental climate is hot in summer and cold in winter where the maximum temperature exceeds 45 °C and its lowest temperature is up to 0 °C.

For instance, Sukra, Viscera, and Edbsaran are the names that the Arabs and the foreigners used in different senses for Biskra. Some name it "Phisapra", which means a place of commercial exchange because of its geographic location. Others believe that its name is originated from an ancient Roman name "Edbsaran" considering its famous thermal complex (Hammam Essalhin). However, some others believe that its name is Sukra because of its delicious dates. Biskra is ranked among the historic cities that have been preserved since ancient times.

The discovery of a large collection of parts and stone tools used by the human, who settled in Biskra tens of thousands of years ago, is confirmed by archaeological excavations. These tools are the heads of arrows and mops and mascots, which suggest that the city of Biskra was inhabited since the stone age. In addition, historians, particularly Ibn Khaldun, confirmed its inception more than 6000 years ago and stated that Biskra is the capital of Ziban in terms of the oases. Furthermore, it is also confirmed that the city is a gateway between the north and the desert of Algeria and thus it is a commercial link between them. The original inhabitants of Biskra are called Berber. It was colonised by the Romans, the Vandals, the Byzantines, the Ottomans, and then by the French.

Figure N° 1: Geographic location of the case of study "Biskra"



Source: https://www.ezilon.com/maps/africa/algeria-physical-maps.html

Problem and proposal of the case study

The urban planning of new urban extensions and new cities is a great challenge for both planners and designers because it requires a systematic investigation and research that go beyond the comprehensive as well as the detailed dimension to the dialectical variables of human behaviour and projections of the use of space by human beings. The New West Urban Extension of Biskra "New Urban Pole "Mohammed Issami" is one of the new urban extensions that Algeria has used to relieve pressure on the mother city of Biskra. However, despite the implementation of various urban plans in this new urban extension, many new problems have created like the negative use of its several urban spaces.

This was caused by the urgency in pushing urban planning toward implementation without contemplating the precise mechanisms in order to evaluate the final planning product before the completion, vacancy, and human use. This has negatively reflected on the well-being expected by the citizens and has created real problems that can provoke the criminal act and behaviour. This could have been avoided if the urban schemes would have analysed by using an efficient computer mechanism that is represented in the visibility map originating from the theory of Space Syntax. The reason is that what can be considered readable are the common visual constants in humans, so one can start identifying the hot spots and safe points in the urban environment of a city, from which safe spaces can be created (also they can be called defensive spaces).

Literature review

The new urban extensions and new cities throughout history have represented the preoccupation of urban policies and followed many theories and urban planning methods. Many studies have addressed the problems of the implications of urban planning after implementation. We have selected those studies that are relevant to the subject of our study; these are as follows:

The study by Czerkauer-Yamu and Voigt opens the horizons of strategic planning based on modelling and simulation, and it has proved that the Space Syntax approach has added value to strategic planning and urban design that enable access to a sustainable future environment (Czerkauer-Yamu and Voigt, 2011, pp.125-133).

The study of Karimi shows that the urban design context can be improved by using the methods of computing analysis based on space syntax theory at certain stages of the design process. This helps in evaluating the design outputs and developing the design solutions, and thus reducing the risk of failure during the project design or implementation (Karimi, 2012, pp.1-22).

Stonor showed that through sensing, outlooking, mapping, analysis, interaction and testing, the urban structure that is required to be designed can be understood. The computer-aided method that followed the Space Syntax theory of the second or the third dimension has helped in decision making at different levels of different urban plans (Stonor, 2014, pp.1-8).

It is the first study that developed the relationship between space and crime within the city and followed the approach of Space Syntax. Alford examined the configuration of the inner city and the distribution of crime on its streets (Alford, 1996, pp.45-76).

In the study by Newman, the researcher concluded that during the stages of the design of defensible spaces from crimes, it is necessary to consider two basic components. Firstly, the space should be visible by people. Secondly, people should be constantly visible or reporting about the crime as it occurs (Newman, 1996, p.101).

Kate et al. developed procedures that seek to produce potential hot spot maps in order to determine the likely future locations of crimes (Kate et al., 2004, pp.641-658).

Hillier and Sahbaz concluded that the relationship between the space design and security is associated with the safety in numbers by identifying hot spots in urban space by using the computer-based Space Syntax, which is based on the relationship of social factors and spatial factors (Hillier and Sahbaz, 2008, pp.1-28).

Further, Hillier and Sahbaz, in order to gain an understanding of crime patterns in urban space, analysed the London road network by using a computer-based approach called “Space Syntax” for investigating streets, blocked roads, multi-use spaces, permeability, and density indices (Hillier and Sahbaz, 2012, pp.111-137).

Methodology

The methodologies that are applied in the architecture and urban planning sector include the social methodology based on the study of behaviour, the topological methodology, the architectural conformation, and so on. The Space Syntax computer software is an important scientific tool that is used in the architectural and urban analysis. This tool helps in understanding how human being uses space and interact within it (Assassi, 2017, p.12).

Moreover, the Space Syntax computer software also helps in understanding the social-spatial configuration as a new approach (Hillier, 1996, p.39).

Hillier defines Space Syntax as a family of techniques, which is used for representing and analysing all types of spatial planning. According to the Space Syntax Laboratory of Bartlett School of Architecture at the University College of London, the research on Space Syntax provides a basic understanding about the relationship between the design of space and the use of space as well as long-term social outcomes (Hillier, 1999, pp.169-191).

The Space Syntax approach was developed based on the concept of the spatial plan that directly affects movement (both mechanical and pedestrian movement), the use of space (space use is linked to its location), the safety standard (by detecting danger and creating safe spaces), the value of land (the influence of the space network on real-estate properties), and reduces and increases carbon emissions (urban planning relation to the environment).

Moreover, the spaces can be divided into a set of components that can be analysed as networks of choices, which are represented in the form of a map and graphs that classify the values of connectivity between spaces and their integration values. According to this approach, the design principles of the space can be determined in three ways, namely, by using the raster graphs, which includes the total area or size that can be seen from a point; the convex space, which includes an area where no line between two points penetrates its surroundings; and the axial line, which includes the straight axis of the feet. Moreover, these three principles can be obtained from three different types of maps: the first map is called the convex map, which contains a set of convex spaces; the second map is called the axial map, which represents the minimum number of axial lines surrounding the convex spaces and their links; and the third map is called the depth map, which represents the size of the visible field from the convex spaces or axial lines.

The application of the Depthmap program (the free original version) and the framework of the Video Graphics Array system (VGA) help in achieving the visual spatial relations within the field from the Depthmap. Furthermore, we can analyse the second-dimensional schemas that are converted into the DXF file. In order to find visual sites from each location point in the chart one after the other, we can fill the open fields of this chart with a network of points. This program uses a simple point for the test with the launch of rays to reach the goal.

Each site has an edge, and thus all sites form a set of edges and are saved. In Depthmap, the colour values formed across the graph are based on the spectral field, i.e., from the indigo colour with low values to the blue, purple, green, yellow, orange, red and purple colour with increasing values. In this case, the low values show the ease of movement and the high values reflect the difficulty in movement (Pinelo and Turner, 2010, p.27).

In order to characterise and determine the defensive status of a space (strong or weak) of criminality, the following indicators are considered in this case study:

Connectivity: This indicator is applied to measure the number of spaces directly related to a specific space (constant local measurement). Hence, the lack of links indicates a small flow of any field, which means that this space can attract crime.

Clustering Coefficient: This indicator measures the intra-visibility of points. The clustering coefficient simply represents the degree of points visible from a point and also visible to one another. Therefore, it is considered as a measure of the visual compactness or the convexity of the isovist of a point. Moreover, the points in corners of rooms show higher values as compared to points in corridors that allow fragments of views into several adjoining spaces through narrow doorways.

Control: This indicator is applied to measure the degree of control of a specific space taking into account the neighbouring spaces (considering the alternative links that these spaces possess). The control is a local measurement that is not static but moving. If the value of the control is small, it indicates that the space cannot be monitored and therefore it may be a space where crime can likely occur.

Point Depth Entropy: This indicator helps in exploring the measurements of the distribution depth frequency. The value of the point depth entropy shows if the vision from a particular point is permeable within the spatial system or not. The point depth entropy has lesser number of edges that required to be crossed from one point to another. In addition, the point depth entropy shows the average number of turns per distance travelled by the domain user within the system. In other words, it indicates the change in potential information associated with the justified graph of the space from that point.

Integration: This indicator measures the average depth of the spaces and determines the accessibility to another spatial part (global static measurement). On the contrary, it indicates that the isolated space can be proved an attractive space for a crime.

Analysis of the Case Study

As mentioned above, the New West Urban Extension of Biskra “New Urban Pole “Mohammed Issami”” is an urban structure that is consisted of five units (Figure n°2). In this paper, we study a part of the Land Occupancy Layout No. 29 to follow a procedural hypothesis that states: Although Land Occupancy Layout No. 29 is located in the urban center of New West Urban Extension of Biskra “New Urban Pole “Mohammed Issami””, it is in full contact of the intersection point of two main axes in this new urban extension, but it is not free of hot spots. This is confirmed by the applications of the computer vision map known as Depthmap. Although this neighbourhood unit is a central area, this asserts that there are many hot zones in units far from the urban center.

Figure N° 2: Localisation of the case study in Biskra
Source: Google earth, 2018

Figure N° 3: Photo of the case study
Source: authors, 2018

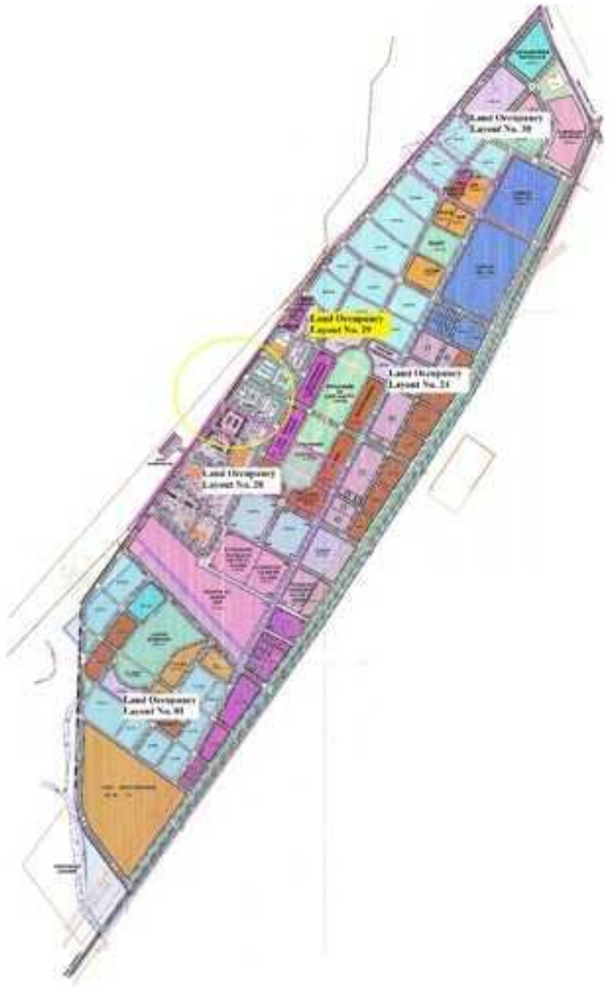


Figure N° 4: Localisation of the Land Occupancy Layout No. 29 in the case of study
Source: Archives of the Urbanization Directorate of Biskra, 2017

In the next part, we will find the graphs of the five indicators mentioned above with the results of their numerical analysis.

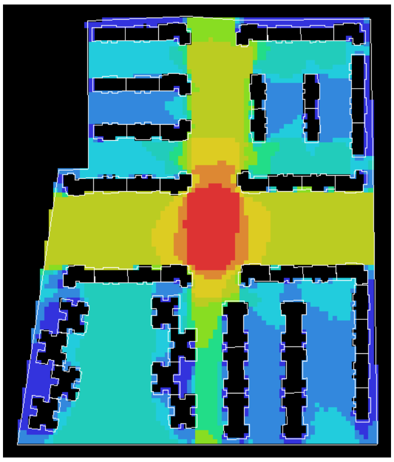


Figure N° 5: Visibility map: Connectivity of the Land Occupancy Layout n°29
Source: authors, 2018

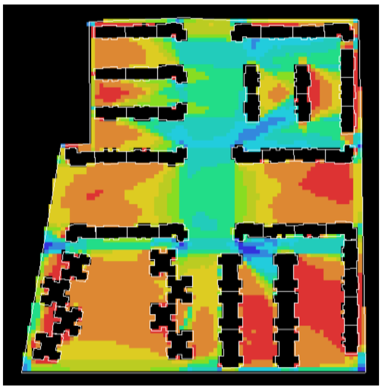


Figure N° 6: Visibility map: Clustering Coefficient of the Land Occupancy Layout n°29
Source: authors, 2018

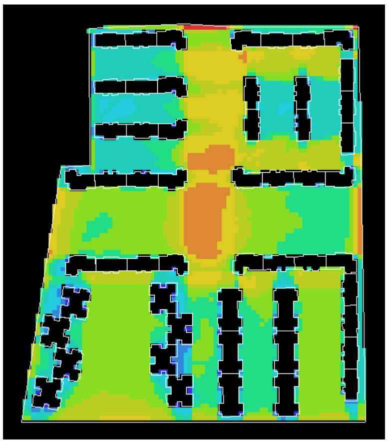


Figure N° 7: Visibility map: Control of the Land
Occupancy Layout n°29
Source: authors, 2018

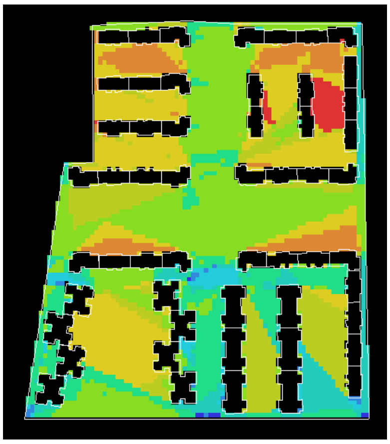


Figure N° 8: Visibility map: Point Depth Entropy of the Land
Occupancy Layout n°29
Source: authors, 2018

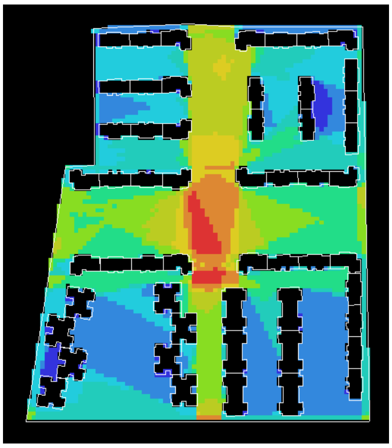


Figure N° 9: Visibility map: Integration of the Land Occupancy Layout n°29
Source: authors, 2018

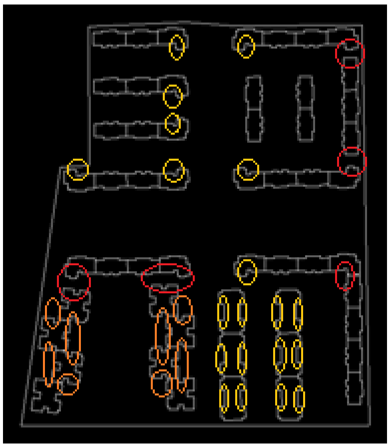


Figure N° 10: Hot spots distribution scheme of the Land Occupancy Layout n°29
Source: authors, 2018

	Connectivity	Clustering Coefficient	Control	Point Depth Entropy	Integration
Maximum	2026	1	1, 85204	2, 10977	1, 34816
Average	821, 878	0, 785515	1	1, 6278	0, 754301
Minimum	5	0, 362563	0, 0426353	0, 911438	0, 362039

Figure N° 1: The results of applying the visibility map
Source: authors, 2018

Figure 5 illustrates the visibility map of the connectivity indicator of Land Occupancy Layout No. 29. It shows that the most connected space is the area of intersection of the main and branch roads with a maximum value of 2026. Moreover, it is observed that there are many spaces that have values as low as 5 in the dark blue or indigo space, which includes dead corners, spaces between blind facades, spaces with semi-closed triangle form and narrow inner spaces. The average value is considered to be specific to the rest of the dark green spaces (which tend to blue).

Figure 6 illustrates the visibility map of the clustering coefficient of Land Occupancy Layout No. 29. It is observed that this indicator shows low values in blue in the same spaces that recorded high values for the connectivity indicator but with a minimum value of 0.362563, and shows high values in the same spaces that recorded low values for the connectivity indicator but with a maximum value of 1. The rest of the spaces are considered moderate (generally, low values are recorded in the center of the built rings and high values in their inner corners).

Figure 7, which represents the visibility map of the control indicator, illustrates that the high values in red, orange and yellow are found in the same spaces where the high values of the connectivity indicator are located but with a maximum value of 1.85204. In addition, in the same spaces where the low values of the connectivity indicator are located, the low values of the control indicator are found but with a minimum value of 0.0426353.

Figure 8 illustrates the visibility map of the point depth entropy indicator. It is observed that this indicator shows the same distribution for the high and low values as the clustering coefficient but with a maximum value of 2.10977 and a minimum value of 0.911438.

Figure 9, which represents the visibility map of the integration indicator, illustrates the same values as the distribution of values for the connectivity indicator but with a maximum value of 1.34816 and a minimum value of 0.362039.

Discussion

The connectivity indicator values show that the spaces with high values are characterised by a lot of movement (from, across and to the movement). Moreover, the spaces with fewer links are the low-flow transit spaces, which are likely to attract bad behaviour like criminality. It is reported that there is a significant difference between the low values of non-connecting spaces and the high values of other spaces.

The clustering coefficient indicator values show that the principle of assembly is clear from public, semi-public, semi-private and private spaces, but the architectural design of the buildings planned by the designer created many blind corners, which generated isolated areas that could cause the criminal act at any moment.

The control points are clearly visible in the spaces where their values are high, especially at the intersection points of axes where people can see many spaces and also these people can easily be monitored, and the blue spaces are considered hot spots with very little control (to and from). This result is supported by the defensive spaces that have low values as compared to the point depth entropy indicator and by the weakness of the other spaces, especially those located in the dead corners, fall between the blind facades and found in the semi-closed triangle form (acute triangles), in addition to the narrow inner spaces.

The integration indicator values show that the intersections of the main and branch roads, and central squares, are the most integrated spaces in the architectural structure of Land Occupancy Layout No. 29, and the less integrated spaces help in exhibiting criminality.

Based on the above five visibility maps, a total of thirty-three hot spots are obtained as shown in Figure 10. These hot spots are classified as follows: five very dangerous hot spots, which are indicated with the red colour; eight dangerous hot spots, which are indicated with the orange colour; and twenty less dangerous hot spots, which are indicated with the yellow colour.

CONCLUSION

In this study, a total of thirty-three hot spots are identified which can be considered as attractive spaces for the practice of criminal behaviour. This is performed by using the computer visibility map, which is one of the main tools of the Space Syntax approach. Moreover, this approach is based on the five indicators that are consistent with the distribution of these spaces according to their analytical characteristics. By using this approach, the validity of the procedural hypothesis mentioned at the beginning of the analysis is proved, which is related to the Land Occupancy Layout No. 29 of the New West Urban Extension of Biskra "New Urban Pole "Mohammed Issami"". Therefore, this approach further recommends the study of the rest of the neighbouring units. Finally, we must prevent traditional planning errors by using digital prospective assessment and evaluation in order to avoid criminal acts in urban spaces.

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