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Araştırma
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Quantitative Analysis of Street Network Features Using Space Syntax and GIS-Based Approaches: Ordu (Akyazı Neighborhood), Türkiye

Murat YEŞİL [1], Rabia Nurefşan AÇIKGÖZ [1*], Eda ŞENTÜRK [2]

[1]Ordu Üniversitesi, Ziraat Fakültesi, Peyzaj Mimarlığı Bölümü, Ordu/TÜRKİYE
[2]Ordu Üniversitesi, Fen Bilimleri Enstitüsü, Ordu/TÜRKİYE

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Sorumlu yazar: Rabia Nurefşan AÇIKGÖZ, e-posta: rabiakarabork9@gmail.com

Abstract

Objective: This study aims to examine the relationship between visual accessibility and spatial components of different observation points in Akyazı Neighborhood of Ordu province by using space syntax, long line of sight and buffer analyses.

Materials and Methods: Space syntax was conducted in Akyazı Neighborhood. According to this analysis, three different observation points (G1, G2 and G3) were determined at the intersection points of the high value paths of the sequential analysis. Long line of sight and buffer analyses were performed for these points. The data obtained were evaluated comparatively.

Results: The results of the analysis show that G1 has the highest level of visual accessibility, whereas the viewing capacities of G2 and G3 are more limited due to spatial constraints. The main reasons for the differences in the level of visual accessibility are spatial factors such as spatial structure, connectivity values, building density, presence of open space, narrow streets, building heights and environmental barriers. Sequential analyses determined accessibility levels through connectivity and integration values, and when evaluated together with long line of sight analyses, the spatial relationships between accessibility, visual perception and pedestrian mobility became more evident. Buffer analysis revealed the relationship between walkability and accessibility levels and spatial organization through buffer zones created around the observation points.

Conclusion: The results show that space syntax, long line of sight and buffer analyses are important evaluation tools in urban design and spatial planning. In order to increase visual accessibility, it is evaluated that elements such as building density, open space planning and street design should be handled in a holistic manner. In this context, the study suggests that the combination of space syntax, long line of sight analysis and buffer analysis can be an effective method to design urban accessibility, walkability and spatial perception more efficiently in Akyazı Neighborhood.

Keywords: Accessibility, GIS, visibility, spatial configuration, space syntax

Mekan Dizimi ve CBS Tabanlı Yaklaşımlarla Sokak Ağı Özelliklerinin Niceliksel Analizi: Ordu (Akyazı Mahallesi), Türkiye

Öz

Amaç: Bu çalışmada; mekan dizimi analizi, uzun görüş hattı analizi ve tampon analizi kullanılarak Ordu ili Akyazı Mahallesi'nde farklı gözlem noktalarının görsel erişilebilirlik ve mekansal bileşenler ile ilişkisini incelemek amaçlanmıştır.

Materyal ve Yöntem: Akyazı Mahallesi'nde mekan dizimi analizleri gerçekleştirilmiştir. Bu analize göre dizimsel analizin yüksek değer alan yollarının kesişim noktalarında üç farklı gözlem noktası (G1, G2 ve G3) belirlenmiştir. Bu noktalar için uzun görüş hattı analizleri ile tampon analizleri yapılmıştır. Elde edilen veriler karşılaştırmalı olarak değerlendirilmiştir.

Araştırma Bulguları: Analiz sonuçları, G1'in en yüksek görsel erişilebilirlik seviyesine sahip olduğunu, buna karşın G2 ve G3'ün görüş kapasitelerinin mekansal kısıtlılıklar nedeniyle daha sınırlı kaldığını göstermektedir.

Görsel erişilebilirlik düzeyindeki farklılıkların temel nedenleri, mekansal yapı, bağlantılılık değerleri, yapı yoğunluğu, açık alan varlığı, dar sokaklar, bina yükseklikleri ve çevresel engeller gibi mekansal faktörlerdir. Dizimsel analizlerin bağlantılılık ve bütünleşme değerleri üzerinden erişilebilirlik düzeylerini belirlemiş, uzun görüş hattı analizleriyle birlikte değerlendirildiğinde, erişilebilirlik, görsel algı ve yaya hareketliliği arasındaki mekansal ilişkilerin daha belirgin hale geldiği görülmüştür. Tampon analizi, gözlem noktalarının çevresinde oluşturulan tampon bölgeler aracılığıyla yürünebilirlik ve erişilebilirlik düzeylerinin mekansal organizasyonla ilişkisini ortaya koymuştur.

Sonuç: Sonuçlar, mekan dizimi analizi, uzun görüş hattı analizi ve tampon analizinin, kentsel tasarım ve mekansal planlamada önemli değerlendirme araçları olduğunu göstermektedir. Görsel erişilebilirliğin artırılması için yapılaşma yoğunluğu, açık alan planlaması ve sokak tasarımı gibi unsurlarla bütüncül bir şekilde ele alınması gerektiği değerlendirilmektedir. Bu bağlamda çalışma, Akyazı Mahallesi'nde kent içi erişilebilirlik, yürünebilirlik ve mekansal algının daha verimli tasarlanabilmesi için mekan dizimi analizi, uzun görüş hattı analizi ve tampon analizinin birlikte kullanılmasının etkin bir yöntem olabileceğini önermektedir.

Anahtar kelimeler: Erişilebilirlik, CBS, görünürlük, mekansal yapılandırma, mekan dizimi

Introduction

Cities are undergoing significant changes due to rapid population growth and uncontrolled construction (Xiao et al., 2022). Today's research highlights the creation of sustainable and accessible living spaces to reduce the pressures of urbanization on the urban environment (Rana, 2011; Riffat et al., 2024). The concept of accessibility supports equal use of public spaces, access to key destinations for all city dwellers, and active participation in urban life (World Health Organization, 2018). It can also be defined as the ease of transportation to a specific point (Cascetta et al., 2013). Analytical methods that measure accessibility shape urban planning, directly affecting both mobility and urban structure.

Walkability is an important parameter for urban environment accessibility. Like other aspects of human activity, walking is influenced by cultural norms, induvial contexts, preferences and the conditions of the physical environments (Mehta, 2008). Walking takes place in linear spaces (axial/one dimensional lines) such as streets and avenues outside buildings in the urban fabric or in geometric spaces (two dimensional convex elements) such as squares, parks, intersections (Kürkçüoğlu and Ocakçı, 2015). The ease and comfort of pedestrians' movement in these environments is considered as an indicator of the quality of public environments (Southworth, 2005; Martino et al., 2019).

The concept of walkability is affected by various factors such as the street typology, their connection features, land use (Yazicioğlu and Yürekli, 2011). Other factors affecting walkability include the presence of obstacles, sidewalk conditions, road gradients, personal safety, pedestrian-oriented infrastructure and urban components such as benches, shelters and lighting. At the same time, amenities such as sidewalk width, vehicular traffic, the built environment and access to green infrastructure also affect walkability and ultimately contribute to creating livable urban environments and communities (Eren, 2022).

Essentially, it is possible to define pedestrian movement as a dynamic and social reflex shaped by the built environment and human mobility. Spatial configuration plays an important role in shaping human actions and interactions, largely determining the social character of space. In this context, the analysis of urban environments in which individuals live is a valuable approach to determining urban areas that direct social behavior (Othman et al., 2020). In this regard, the space syntax is an important analytical framework developed to examine the relationship between movement morphological features of the built environment (Hillier and Hanson, 1984).

The space syntax method increases the scope and depth of spatial analysis by integrating with different methodologies such as geographic information systems (GIS) and agent-based modeling (Zhou, 2008; Omer and Kaplan, 2017; Esposito et al., 2020).

This study was carried out in Akyazı Neighborhood of Ordu (Türkiye), an area that is densely used for residential purposes and also contains public, commercial and recreational areas. The main objective of the study is to evaluate the relationships between the visual qualities of street networks, built-up areas and urban activities using space syntax and GIS methods. In this context, the interactions between the spatial organization of street networks, accessibility and mobility, and the formal features of the built environment were analyzed to better understand the social and functional dynamics of urban space.

Material and Method

Material

The study was carried out in Akyazı Neighborhood of Ordu, one of the provinces in the Eastern Black Sea Region of Türkiye (Figure 1). Akyazı Neighborhood has an area of approximately 156 hectares and its resident population is 15,315 people (TURKSTAT, 2024). While the neighborhood attracts attention with its walking paths and food and beverage venues, especially along the coast, it also contains public buildings such as hospitals and schools. This functional diversity causes the area to be used intensively during the day, not only by the resident population, but also by visitors from outside the neighborhood, leading to a significant increase in the immediate population of the neighborhood.

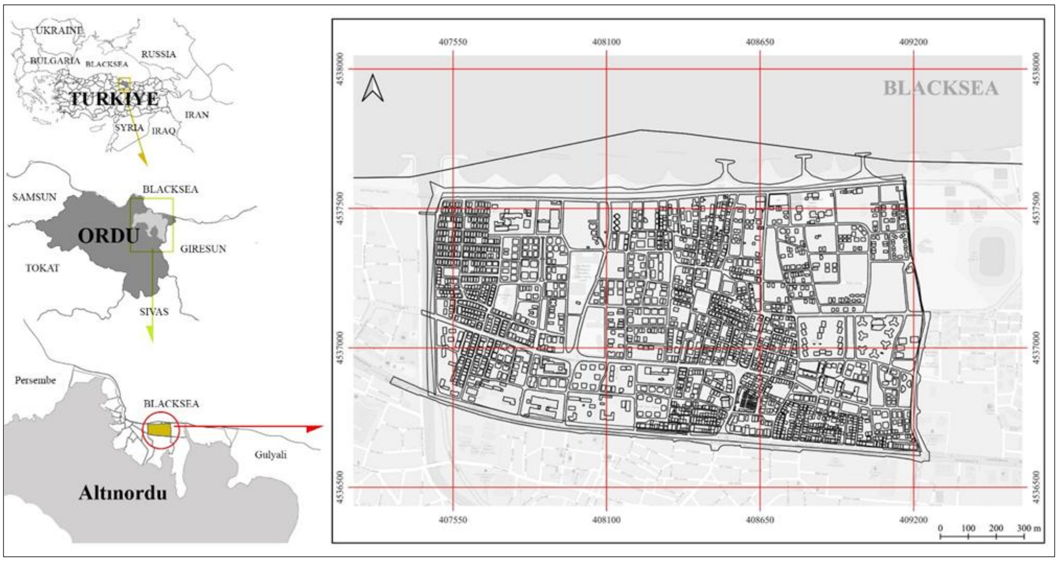

Figure 1. Location of Akyazı Neighborhood

Method

In the study, two main methods were adopted to investigate the spatial characteristics of the neighborhood and to evaluate its visual relationship with urban activities. These are;

1. Space syntax
2. GIS etc.

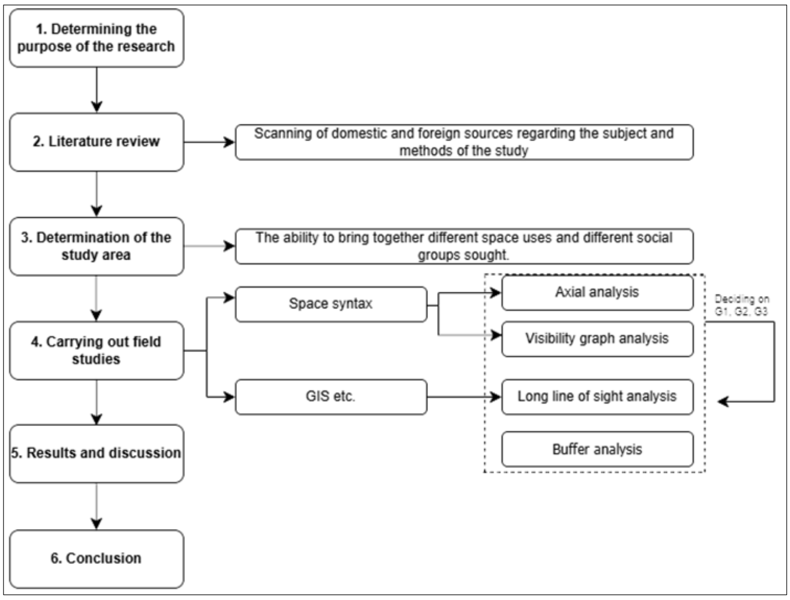

Figure 2. Method diagram

Space Syntax Analysis

Space syntax is based on research conducted by Hillier and his team at University College London (UCL) in the 1970s. Space syntax focuses on the sense of sight and movement ability by adopting a simple model when analyzing the interaction between people and the environment they live in (Karimi, 2023). This method analyzes physical environment of different types and scales, revealing various spatial relationships based on the coincidence of the longest and least number of people's sight lines (Kubat, 2015). In the analysis process, a representation map of street networks is created using intersecting sight lines or axial lines, and graphical and theoretical syntactic measures are performed to make predictions and evaluations (Jiang and Liu, 2009).

The study titled "*The Social Logic of Space*", which reveals the theoretical infrastructure and analysis techniques of the method, has made an important contribution to the academic literature and has become a basic reference for subsequent research (Hillier and Hanson, 1984; Kubat, 2015).

Essentially, space syntax encompasses a series of methodological processes aimed at understanding the effects of spatial formation on land use, human social life and behavior through modeling and analyzing spatial environments with different scales and forms (Gündoğdu, 2014; Sıkoğlu and Arslan, 2015). According to the theorists of the method, the basis of these methodological processes is based on the concepts of "structuring" and "human movement"; in addition, the represented relationships between spaces are addressed within the framework of "accessibility" (Can and Heath, 2016).

This approach has created an important research area for disciplines such as architecture, urban and regional planning, and landscape architecture that deal with the built environment, and has enabled the space syntax literature to have a multidisciplinary structure (Yamu and Nes, 2017; Griffiths and Vaughan, 2020; Turgut, 2022). It is accepted that spatial configuration plays a determining role in human movement and interaction patterns. In other words, there is a direct relationship between spatial configuration and urban activities (Karimi, 2018).

The space syntax approach provides analytical tools to make sense of the interrelationships between the spatial system and its users (Zaninović et al., 2018). The most common research topics of this method include walkability analysis, land use, spatial perception and legibility studies, transportation planning and public transportation systems (Liu and Jiang, 2012; Topçu and Topçu, 2012; De Koning et al., 2017; van Nes, 2021; Yeşil et al., 2024).

Calculation of Syntactic Parameters

In carrying out the space syntax analyses, the current settlement plan of the study area was obtained from local governments and used. In order to apply syntactic analysis, the study area was converted to .dxf format and transferred to the open access software DepthmapX 0.8.0 (DepthmapX Development Team, 2024). In this software, the axial map that forms the basis of syntactic analyses was produced and then connectivity, global integration (HH) and local integration ([HH] R3) analyses were performed. In the last stage, the variables obtained from the axial maps were transferred with their attributes to open access geographic information systems (GIS) software such as QGIS 3.36.1 and visualization processes were performed.

In syntactic analysis, the connectivity value represents the total number of intersections of elements such as streets or avenues that define the spatial environment with only their immediate neighbors (Hillier and Hanson, 1984). Connectivity is a static and local measure, indicating that places with high values have strong connections to other places in the system and are easily accessible (Xu et al., 2020; Heo et al., 2021; Van Nes and Yamu, 2021).

The mathematical expression of the connectivity value is given in Equation 1. In the equation, C_i is the connectivity value of axis i and k is the total number of axles crossing axis i.

$$C_i = k \tag{1}$$

In the syntactic method, the concept of depth refers to the number of steps and changes in direction required to move between spaces (Peponis et al., 2002). A high number of directional changes during transportation from one space to another indicates that the space is deep; a low number indicates that the space is shallow (Jiang et al., 2000).

The mathematical expression of depth is given in Equation 2. Accordingly, Di represents the depth value, n represents the total number of axles and dij represents the minimum number of steps between axles i and j.

$$D_i = \frac{\sum_{j=1}^{n} d_{ij}}{n-1} \tag{2}$$

The integration value is one of the most important parameters of the space syntax analysis and in order to obtain the value, the average depth value must first be known (Hillier and Hanson, 1984). Integration value is the analysis of the relationship of a place with the whole system in which it exists (Van Nes and Yamu, 2021). The value gives a mathematical expression of spatial accessibility, mobility between places. A high integration value indicates that a place is more easily accessible to the rest of the system, while a low integration value indicates that it is more isolated. With a global integration value, the entire system with radius n is analyzed, while with local integration values, areas limited to radius 3 or radius 5 can be analyzed. The concept of radius here refers to the number of axle where the movement will take place (Baran et al., 2008).

The mathematical expression of the integration value is given in Equation 3. In the equation, Di represents the depth. In the given equation, Ii represents the integration value of the space numbered i in the system, n represents the number of spaces in the system, and MDi represents the average depth.

$$I_i = \frac{n\,(\log_2((n+2)/3) - 1) + 1}{(n-1)(D_i - 1)} \quad (3)$$

Visibility Graph Analysis (VGA)

The concept of visible area expresses how space is defined from a certain point of view within the spatial environment where perception and movement occur. By using space syntax analyses, the visible parts of the spatial environment in which individuals are located can be modeled through “visibility graphs”. This method allows the recognition of local and large-scale spatial relationships as well as perceived built environment features (Hillier and Hanson, 1984; Turner et al., 2001).

Visibility graphs are created by placing a specific grid on a residential area plan and applying syntactic methodologies. In this framework, measurements such as the isovist area are calculated for individual grid cells using topological methods to assess the proximity and visibility between cells (Turner, 2003). The resulting analyses and visualizations are widely used to investigate spatial configurations of spaces that have the potential to affect urban activities.

GIS (Geographic Information Systems) Approach

The utilization of advanced geographic analysis software facilitates the execution of accessibility and walkability measurements in a more meticulous and systematic manner. In this context, ArcMap and ArcScene software offer a broad array of applications, ranging from distance-based analysis to complex accessibility models. These software tools facilitate more efficient analysis processes (Esri, 2025a). These software tools offer a comprehensive suite of capabilities for the visualization, analysis, and interpretation of spatial data, thereby facilitating a more profound comprehension of urban environments in terms of accessibility and mobility.

While 2D GIS is a prevalent method in planning processes, it has limitations in visualizing and analyzing sensory information of physical objects, such as texture, shape, size, or their solid form, including spatial relationships such as vertical dimensions, height, volume, and area (Yin and Shiode, 2014).

In contrast, 3D GIS models create virtual environments based on three-dimensional representations of buildings, trees, and other urban objects, allowing for a more intuitive and comprehensive understanding of complex spatial relationships in the urban fabric (Day, 1994; Shiode, 2001; Yin, 2017). The advanced analytical capabilities afforded by 3D GIS offer significant advantages, particularly in the evaluation of issues such as height, shadow effects, building density, and visibility analysis.

Long Line of Sight Analysis

Long sightline analysis is widely regarded as a pivotal factor influencing pedestrian mobility and spatial perception, playing a critical role in understanding the impact of spatial layout on accessibility. Given that walking behavior is influenced by both the spatial network system and the visibility characteristics of the urban environment, the identification of long sightlines provides a crucial metric for analyzing user orientations and pedestrian movements (Natapov et al., 2024; Haq et al., 2018).

An observation point is considered to have a long line of sight if the long line of sight can exceed a distance of 1000 ft without being interrupted by trees, buildings, or other obstacles (Purciel and Marrone, 2006). The analysis's results reveal that areas designated by green coloration represent regions that are directly visible from the specified observation point. Conversely, red areas indicate regions that are not visible due to environmental barriers (Abuazab, 2021). This visualization serves as a valuable instrument for analyzing visibility, pedestrian mobility, and accessibility levels in urban areas.

The visual exploration and analysis of spatially referenced data was performed using ArcScene software. ArcScene facilitates the accurate and detailed representation of the objects and features under study, and its efficacy in vision-oriented analysis, particularly in planning and design processes, has been well-documented (Yin and Hasting, 2007; Yang et al., 2007). The software provides the necessary tools for long line-of-sight analysis, supporting applications such as spatial perception assessment, accessibility modeling, and urban landscape analysis. Consequently, it facilitates a three-dimensional understanding of spatial relationships in areas such as urban planning, transportation planning, and environmental analysis.

The long line-of-sight analysis method incorporates three fundamental directions: front, left, and right. The capacity to see a distance of approximately 1000 ft from any given point on the street determines the number of long sight lines at that specific point. The presence of long sight lines in all three directions at a specific point is indicative of three such lines, as asserted by Purciel and Marrone (2006).

At the stage of determining the observation points in the study, the roads with the highest connectivity and global integration values in the space syntax were determined. Three different nodes on these roads were decided to be the observation points (G1, G2 and G3) of the long line of sight analysis. These nodes constitute the intersection point of the paths with different syntactic values in the neighborhood. At the same time, the way groups of buildings come together and urban voids, in other words, the mass-space relations of the neighborhood, were also taken into consideration when deciding on the observation points.

The observation points for each class were modeled with a height parameter of 5.5 ft, representing the human eye level (Yin, 2017). The creation of extended sight lines was facilitated by employing the Visibility tool within the 3D Analyst extension of ArcScene software, followed by the generation of sight lines through the utilization of the Construct Sight Lines command. This methodological approach offers a significant framework for analyzing the visual perception and accessibility of urban space.

Buffer Analysis

Buffer analysis is a widely used method in spatial analysis. It allows the creation of an impact zone within a defined distance around a certain point, line, or area. This analysis is regarded as a significant method for detecting and evaluating areas within the specified distance (Esri, 2025b).

In this study, buffer zones with a radius of 492 ft were created around the observation points using the Buffer tool in the Geoprocessing extension of ArcMap software (MPYY, 2014). These buffer zones provided a fundamental framework for analyzing accessibility and walkability levels, facilitating an assessment of the effects of urban space on user experience.

Results and Discussion

In the context of space syntax analysis, the generation of axial maps was undertaken to assess the dynamics of movement and accessibility within the designated study area. Axial maps are a significant analytical instrument for depicting human behavior and ascertaining the movement potential in urban areas. These maps are created with the longest and straightest lines, providing an idealized model of movement flows through different transit routes (Khotbehsara et al., 2025). The analysis carried out in the study area reveals that the connectivity value is one of the most fundamental parameters. In the connectivity map presented in Figure 3, this value is represented by an increasing color spectrum from blue to red. In the context of Akyazı Neighborhood, the roads demonstrating the highest levels of connectivity include Ahmet Cemal Magden Street, Atatürk Boulevard, 817th Street, and 15 Temmuz Milli Irade Street. These roads are notable for their high density of movement and accessibility.

These findings underscore the efficacy of connectivity measures derived from space syntax analysis in providing a critical assessment tool for urban mobility and accessibility. In particular, axles with high connectivity values have been identified as routes that are intensively used by both the resident population and users coming from outside the neighborhood.

Ahmet Cemal Magden Street, with a connectivity value of 33, is a pivotal transportation axis situated within the Akyazı Neighborhood. According to the findings of space syntax analysis, streets and avenues with high connectivity values are predicted to be more accessible than other transportation directions. It is further anticipated that these areas will experience heightened user mobility (Van Nes and Yamu, 2021).

Ahmet Cemal Magden Street, which has a high connectivity value, functions as a transit line that carries vehicle and pedestrian traffic from the city center to the inner neighborhoods, which are predominantly composed of residential buildings. The street's function is further enriched by the presence of commercial and public entities, including chain and local markets, food and beverage outlets, and public service buildings such as hospitals and schools. This observation underscores the street's multifaceted role, demonstrating its significance not only as a transportation corridor but also as a pivotal access point and interaction center in daily life.

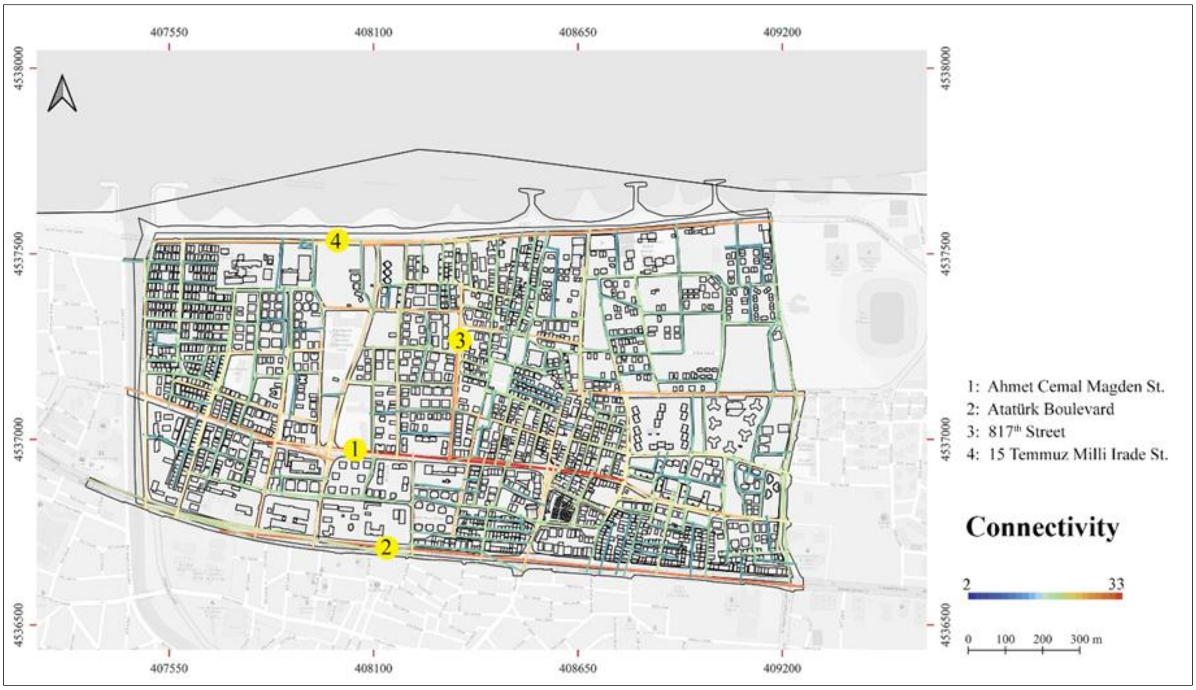

Figure 3. Connectivity map

Another syntactic analysis that was performed in the field was integration analysis. Integration value is expressed as the sum of the turns required to reach an axis. The observation that the number of turns required to access axles with high integration values is lower suggests that these areas are more accessible (Hillier, 2009).

The axial map, with radii Rn and R3, was subjected to analysis, resulting in the creation of global integration (Figure 4) and local integration (Figure 5) maps. The analysis yielded that the axles with the highest [HH]Rn and [HH]R3 values in the Akyazı Neighborhood are Ahmet Cemal Magden Street and the adjacent roads. The highest global integration value of Ahmet Cemal Magden Street is 3.144417, and the highest local integration value is 4.026778. The intersection of Sehit Ali Gaffar Okkan Street and Ali Rıza Gürsoy and Yavuz Sultan Selim Streets, situated at the point of maximum integration, facilitates the transfer of pedestrian and vehicular traffic within the city to the coastal road through a direct, linear route.

The widths of these highly accessible axles, as predicted by the method, range from 10 to 30 meters. However, a number of prior studies conducted in the Akyazı Neighborhood have revealed that, in certain areas, pedestrian and vehicular routes are undefined, lighting elements are inadequate, and the number of pedestrian crossings is absent (Alkan and Yeşil, 2022).

Walkability studies that focus exclusively on the spatial network system may overlook crucial aspects such as users' perceptions and their spatial knowledge of urban activities. For instance, points of interest and visibility features in the spatial environment have been identified as pivotal factors that influence human activities and determine pedestrian movements and orientations (Natapov et al., 2024). Haq et al. (2018), articulated this concept with the phrase "*Where we walk is what we see,*" encapsulating the spatial experience realized through the act of walking. In this context, while walking behavior is defined on a two-dimensional ground, it is understood that third-dimensional information (visibility features) of the environment plays an important role in the decision of where individuals will head.

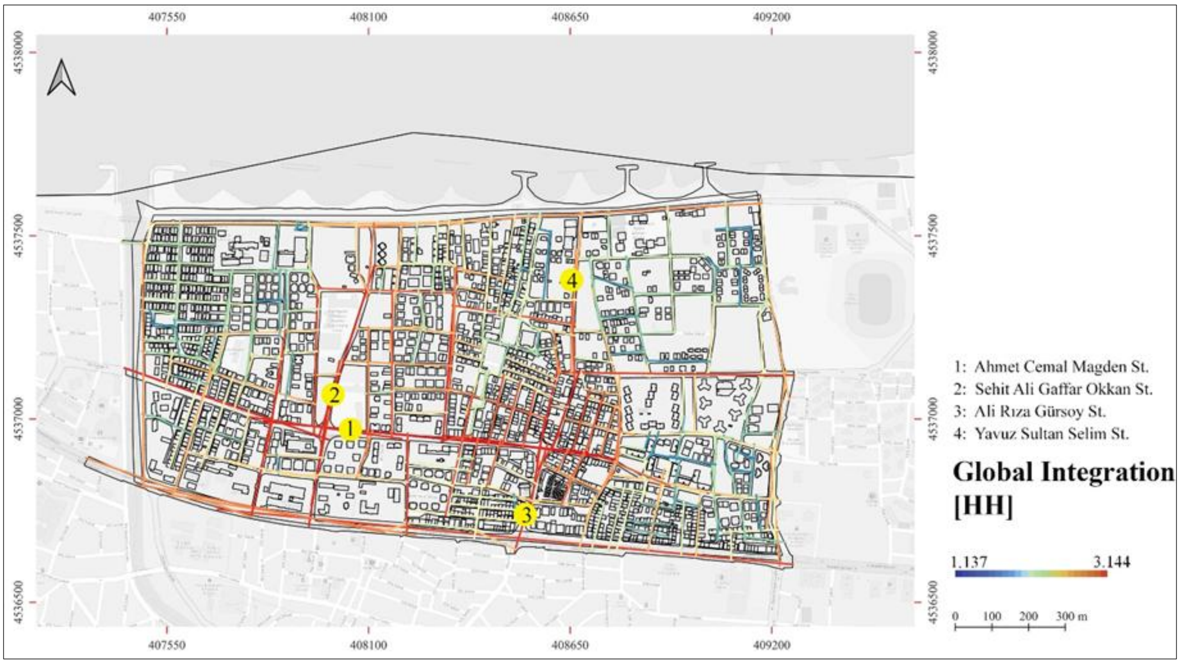

Figure 4. Global integration [HH] map

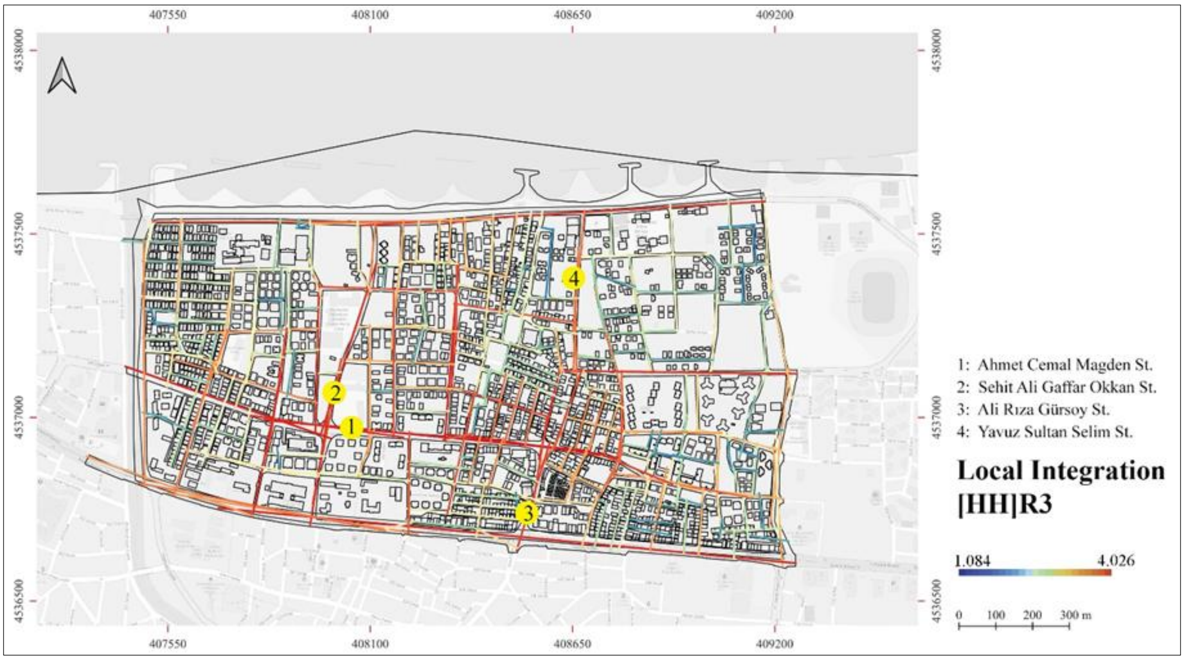

Figure 5. Local integration [HH]R3 map

The visibility analysis conducted in Akyazı Neighborhood reveals that a core area where public buildings such as education, hospitals, culture, and arts are concentrated, as well as the coastal line, are the areas with the highest visibility potential. These findings underscore the necessity of prioritizing not only the network system but also spatial components based on visual perception in urban design and pedestrian mobility analyses. Long line of sight analyses are a valuable source of data regarding pedestrian mobility and spatial perception. However, the continuity of these lines is directly related to the components of the spatial structure, which is shaped by various factors such as building density, natural and artificial obstacles, and topographical elements. Consequently, the level of visual accessibility is contingent on the spatial distribution of urban and natural elements.

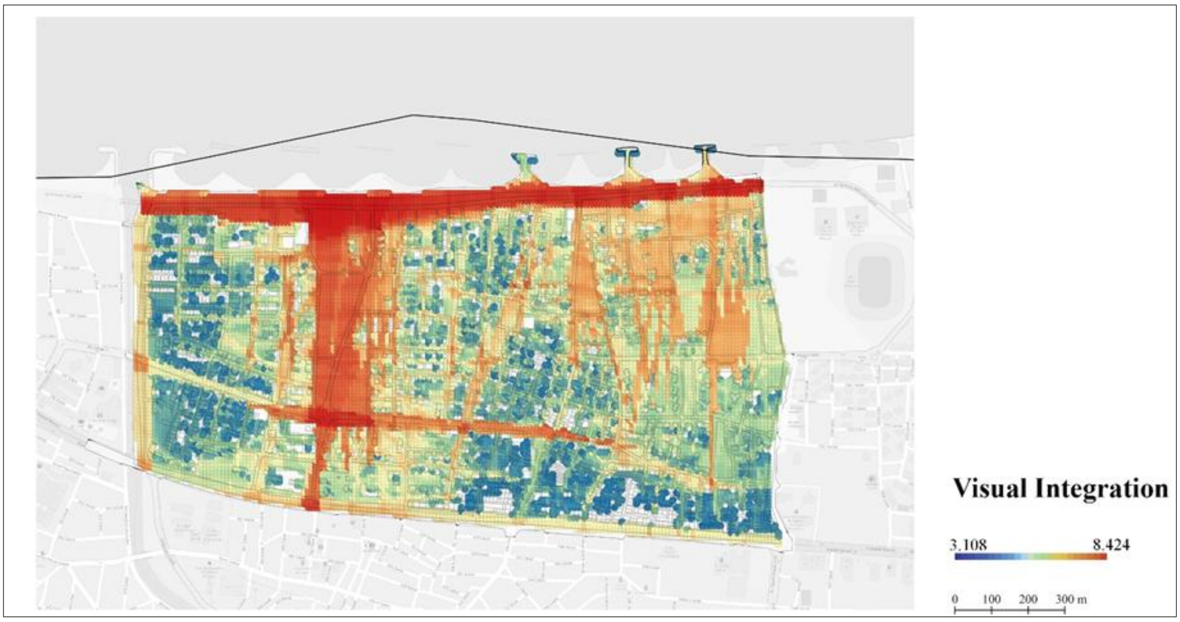

Figure 6. Visual integration map

The findings of long line of sight analyses demonstrate that areas exceeding the 1000 ft distance limit exert a substantial influence on spatial layout with respect to visual accessibility (Jan, 2018). In this context, the long line of sight analyses were rendered visually on the elevation model in a three-dimensional environment, thereby enabling a more intuitive assessment of spatial relationships. The long line of sight and buffer analyses, performed from three distinct observation points, were subjected to detailed scrutiny, thereby facilitating a comprehensive evaluation of the accessibility and perceptibility potential of the urban space (Figure 7) (Figure 8).

Figure 7. Long line of sight analysis and buffer analysis

Figure 8. View of observation points

The analysis conducted at observation point G1 determined the ratio of areas with long line of sight to be 73.68%. This finding indicates that G1 exhibits a more expansive line of sight in comparison to other observation points. The visible areas are predominantly concentrated in regions characterized by open spaces and low building density, while invisible areas are attributable to high building blocks, narrow streets, and environmental obstacles.

The results indicate that the location of observation point G1 has a positive effect on the field of view, suggesting that spatial perception can be evaluated from a broader perspective at this location. This finding underscores the significance of visual accessibility as a pivotal parameter in urban planning and design processes.

The analysis conducted at observation point G2 determined the ratio of areas with long line of sight to be 15.79%. This ratio reveals the limited visibility capacity of G2 and the impact of spatial structure on visual dominance. The analysis reveals a balanced distribution of visible and invisible areas. At this point, where the level of visual accessibility is medium, the impact of environmental factors is evident and the components of the spatial structure play an important role in the formation of visual dominance. Furthermore, the presence of both natural and artificial obstacles was evaluated as factors that limit the visibility capacity of G2.

In the analysis for observation point G3, the ratio of areas with long line of sight was calculated to be 5.26%. This finding suggests that the visibility capacity at G3 is significantly constrained. The analysis revealed that the invisible regions exhibit a wider distribution compared to the visible regions. The visual accessibility of G3 is found to be constrained by factors including the increase in building density, the presence of narrow streets, and environmental obstacles. The components of the spatial structure are identified as pivotal in the reduction of visual dominance at this specific point.

These findings underscore the pivotal role of various spatial components and environmental impediments in disrupting line-of-sight continuity, emphasizing that visual accessibility is a pivotal parameter for urban mobility, wayfinding, and spatial perception.

Conclusion

The primary objective of this study is to examine the relationships between street networks, built-up areas, and the visibility characteristics of spatial environments through space syntax and Geographic Information System (GIS) methods. Spatial syntax offers an analytical framework that addresses issues such as the physical characteristics of spatial environments, accessibility, people's movement patterns, and social interactions. Within the scope of the study, the connectivity, global and local integration values of the sequential method were calculated. The street with the highest value in all indexical parameters was Ahmet Cemal Magden. The axis in question, along with its surrounding axles, bisects the neighborhood horizontally, thereby establishing a comparable transportation spine within the urban landscape. The presence of public buildings, open spaces, and commercial buildings in close proximity to the axis fosters utilization of the area, leading to substantial pedestrian and vehicular movement.

The study examined the visual accessibility levels of various observation points and the spatial components influencing these levels. Long line of sight analyses were employed to assess the accessibility, and the data obtained were used to determine the observation point with the largest visibility capacity. The long line of sight analysis of the study provides an opportunity to examine the spatial distribution of the visible and invisible areas of the observation points from a holistic perspective and reveals the relationship between the differences in the level of visual accessibility and spatial components. The analysis revealed that G1, located on Ahmet Cemal Magden Street, had the highest visibility capacity.

In comparison, the viewing capacities of observation points G2 and G3 are more constrained. The primary factors contributing to these variations are believed to be spatial structure, environmental obstacles, and building density. To facilitate a comparative analysis of the long line of sight analyses for the three observation points, a visual was created. This visual incorporated all analyses, superimposing and overlaying them. This visualization offers a comprehensive perspective on the spatial distribution of observable and obscured areas, facilitating a more nuanced understanding of the interplay between visual accessibility and spatial components. Additionally, buffer zones with a radius of 492 feet were delineated around each observation point to assess accessibility and walkability levels.

The assessment's findings illuminate how visual accessibility at diverse observation points is influenced by environmental factors and spatial configurations. Observation point G1 shows a higher visible area potential than G2 and G3 in the visual integration analysis obtained via depthmapX. Accordingly, G1 located on Ahmet Cemal Magden has a wider field of view as it is located in areas characterized by open spaces and minimum building density, while observation points G2 and G3 exhibit a more limited field of view as a result of their location in areas with dense buildings, narrow streets and environmental barriers. Notably, at observation point G3, it was determined that the invisible areas exhibited a significantly wider distribution compared to the visible areas. The analysis identified narrow street structures, visual barriers imposed by tall buildings, and environmental obstacles as the predominant factors contributing to a diminution in visual dominance at this specific point.

Consequently, it was elucidated that extensive line-of-sight analyses are intrinsically associated with spatial structure and environmental components. A comprehensive consideration of factors such as building density, open space availability, road width, and environmental barriers is imperative to obtain significant data for enhancing visual accessibility within the framework of urban design processes. The study was conducted in a small part of the city, so the study area boundaries need to be expanded for future research. In addition, the study in which the visibility of the area was analyzed can be enriched with landscape aesthetics and visual quality evaluations. These 2D and 3D analyses, which can simulate the visibility of the area in the office environment, should be used as a valuable tool by architects, landscape architects and urban planners in the context of improving urban spatial organization and designing user-friendly urban areas.

Conflicts of Interest

The authors declare no conflicts of interest.

Authorship Contribution Statement

MY: Contributed to determining research questions, constructing the research, writing the text of the article.

RNA: Contributed to conducting literature research, performing space syntax analysis and preparing the article for publication.

EŞ: Contributed to literature review, long line of sight analysis and buffer analysis.

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