Researching for Methods in Visual Analyses of Urban Skylines

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Abstract: *Urban skylines are important components of a city's morphology and are an area of interest for urban design. There are various research areas on urban skylines like protection of historical urban skylines, facade analyses, future models on urban three-dimensional appearances, high building policies and view management. Urban skylines also provide the best visual representations to observe the phenomenon of urban transformation and change. The aim of this study is to form a basis for a multi-component urban skyline aesthetics assessment model that includes formal and socio-psychological dimensions by grouping the methodologies of studies on urban skylines. The information of the urban skyline analyzes developed by the author selected from different countries formed the basis for the study model. Among the methods to be covered, there are approaches such as GIS techniques, aesthetic evaluation with information entropy, fractal geometry, and cognitive studies for urban skylines. The research approach includes the examination and evaluation of applied studies of this area based on literature.*

Keywords: *Urban design, urban skylines, urban aesthetics, skyline evaluation, research methods.*

Kent Siluetlerinin Görsel Analizinde Yöntem Araştırması

Öz*: Kent siluetleri, kent morfolojisinin önemli bileşenleri arasındadır ve kentsel tasarımın ilgi alanıdır. Tarihi kent siluetinin korunması, cephe analizleri, kentsel üç boyutlu görünümler üzerinden gelecek modelleri, yüksek yapı politikaları ve görünüm yönetimi gibi kent siluetleri üzerine çeşitli araştırma alanları bulunmaktadır. Kent siluetleri, kentsel dönüşüm ve değişim olgusunu gözlemleyebilmek için en iyi görsel temsilleri sağlar. Bu çalışmanın amacı, kent siluetlerinin estetik değerleri üzerine araştırma yöntemlerini gruplandırarak, biçimsel ve sosyo-psikolojik boyutları içeren çok bileşenli bir kent silueti değerlendirme modelinin kurgulanması için bir temel oluşturmaktır. Farklı ülkelerden seçilmiş yazar tarafından geliştirilmiş siluet analizlerinin bilgileri çalışma modeli için altyapı oluşturmuştur. Ele alınan yöntemler arasında CBS teknikleri, enformasyon entropisi ile estetik değerlendirme, fraktal geometri ve kentsel siluet için bilişsel çalışmalar gibi yaklaşımlar bulunmaktadır. Araştırma yaklaşımı, konuya ilişkin uygulamalı çalışmaların literatüre dayalı olarak incelenmesini ve değerlendirilmesini içermektedir.*

Anahtar Kelimeler: *Kentsel tasarım, kent silueti, kent estetiği, siluet değerlendirmesi, araştırma yöntemleri.*

1. INTRODUCTION

Urban skylines are the images that remain in the memory of people in interaction with the city. When it is asked about what a city looks like, postcard images often come to mind. While the building texture and facades are important for the architects, urban planners try to understand what the city looks like morphologically. In most cities such as Istanbul's Historical Peninsula, the coastal skylines, which have been conserved to a very limited extent, show the image of a very limited area. But when someone views the image from the skyscrapers, one can see what the city looks like. Figure 1 shows what people want to see when Istanbul is mentioned and Figure 2 shows what the actual shape of Istanbul now looks like. When these two photos are examined the risk of the Istanbul morphology is clearly seen. Various countries such as London apply view management to protect certain historic facade features and coastal views [1]. Most historical cities in Europe, on the other hand, have conserved their historical urban skylines by not constructing new buildings in their historical areas, like Amsterdam and Venice. These skylines can be likened heartbeat of cities or urban cardiograms. Figure 3 shows these regular and irregular urban cardiograms of the city with a metaphoric concept. Different approaches have been developed in sociological, morphological, computer-aided, architectural urban design and environmental psychology scales for the protection of historical urban skylines. Historic cities, especially the river fronts or sea sides reflect their aesthetic characteristics as a skyline image of the urban characteristics as a whole. If a few locations from the same coastal area are selected and photographed every year in metropolises such as Istanbul, the degree of change can be observed. Keeping this change under control depends on aesthetic controls and future simulations. Thus, an opportunity can be found to intervene before architectural projects are applied. At the same time, sharing possible future scenarios with the public can help raise awareness and public support in these areas. Along with the urban image, skylines are important for urban identity.

Urban skylines are a useful analysis scale as an indicator in assessing urban aesthetics and identifying problems related to high-rise policies. The aesthetic value of urban skylines is revealed through sketches, photographs, drawing programs and GIS models. In this field, there are various evaluation methods such as visual-based social media posts, surveys, cognitive studies, mathematical models, computer-aided simulations. This study aims to create a base for a multi-component urban skyline assessment model that includes formal and socio-psychological dimensions by grouping the methodologies of studies on urban skylines. Based on the literature background and previous applications of the author, this research aims to determine the interaction of different methods in the aesthetic evaluation of urban skylines. As a result, all analysis methods are useful tools for protecting historical urban skylines. And also, they point out that the buildings to be built in newly developing cities should be shaped by the design criteria. However, the important thing in this process is to be able to influence city managers on these issues while making decisions and orient them to create a public opinion to contribute to the protection of urban skylines and the improvement of their aesthetic qualities. Facade analysis in architectural studies and interface studies related to facade groups in urban space are also very diverse. This study, as an urban design scale, discussed the methods related to urban skyline scale as seen in Figure 1.


Figure 1. Historical Peninsula of Istanbul (Photograph taken by Author)

Methodologies in architectural facade studies have been excluded in this study. High building policies and legal regulations of the countries are excluded from the scope of this study. Innovative approaches on the aesthetics of urban skylines are considered.

Figure 2. Chaotic view from Istanbul European Side (Photograph taken by Author)
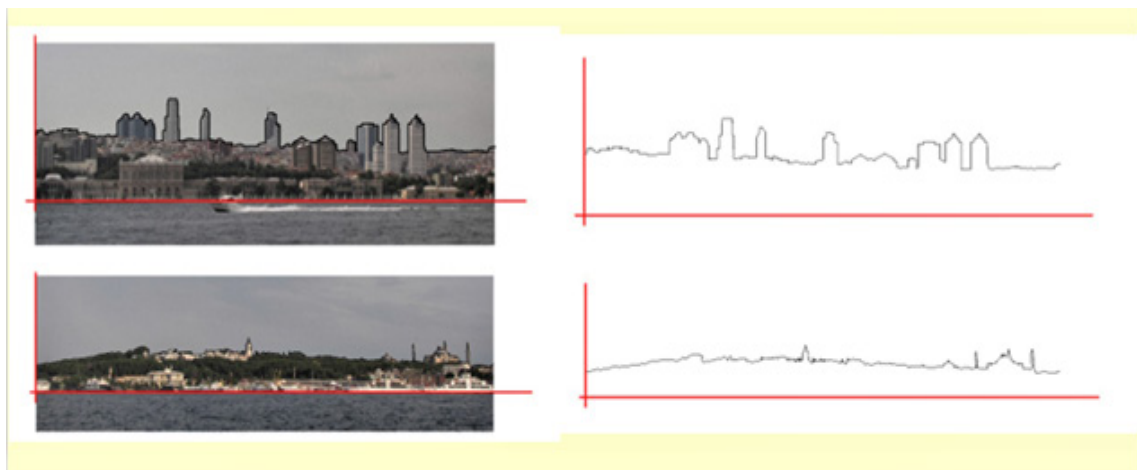
Figure 3. Urban Cardiograms of Istanbul Skyline (Developed by Author)

2. THE CLASSIFICATION FOR ANALYSES OF AESTHETICS OF URBAN SKYLINES

Since the study examines the analysis methods of urban skylines structurally, it includes the research methods in this area. Urban skylines are one of the main application areas in urban design. The aesthetic quality of the elements represents the city as being pleasant or unpleasant for the citizens in the evaluation of the city image. From the scale of the street facade to the scale of the urban skyline, the holistic effect, form

elements and visual harmony constitute the issues that gain importance in aesthetic evaluation. Urban skylines provide a broader combination of architectural, facade and interface evaluations. Within this wholeness, studies are examining both the relations with the sensory space perception and the numerical formal aesthetic criteria for urban skylines. The approaches are combining these researches and applying methods for testing each other. In this study, the methods applied for the aesthetic evaluation of urban skylines have been selected and examined. The author has current studies in these application areas and tested more than fifty skylines from different cities. From these applications, an integrated model has been created.

The research subject of the study includes examining the methods related to the urban skylines. Brief descriptions for the methods have been made. In most of the examples included in the review, different methods supporting the basic method are used together. Research methods in the study are collected under two headings. The descriptive methods reviewed in the first subtitle such as surveys, respondent's opinions, experimental studies. In the second title, some mathematical, statistical and computer-based studies for analyzing the aesthetic quality of urban skylines were examined.

2.1. Descriptive Studies for Analyzing Aesthetic Quality of Urban Skylines

The most common method for determining the aesthetic of an urban view like skyline is to show respondents various visuals and measure their pleasantness about them. A similar approach is done by walking around a research area with respondents and then taking their opinions about this area. In general, since the main goal of the design process is user satisfaction and appreciation, descriptive studies based on user opinions and experiences should be applied additionally to make a check-in different numerical methods. There are different applications in the fields of architecture and urban design, including subjective aesthetic evaluation techniques, mental evaluation techniques, multi-category evaluation techniques, mental estimation techniques, and comparison techniques [2]. In the subtitles of this section researches based on the participants he opinions of the respondents, including questionnaires and experimental studies, semantic differential approximations and cognitive studies on urban skylines have been reviewed.

2.1.1 Studies Made by Understanding Opinion of the Respondents for Urban Skylines

Generally, in aesthetic evaluation studies, city photographs are asked to be rated by respondents about their pleasantness. In these approaches, the participants can be directly asked to what extent they like the visual, as well as their opinions, are examined with experimental approaches and statistical techniques based on questionnaires. Lim and Heath (1994) used qualitative and quantitative data together in researching urban skylines and high-rise building relationships and included opinions of the participants in their studies [3]. For example, there is an urban skyline study carried out, which has been done on the examination of the visual effects of night appearance on people. "Digital colour photographs used on this study for comparing responses to skylines and natural scenes after dark, and skylines during the day. In the first experimental study fifty-nine respondents rate the pleasantness of each scene. They gave similar ratings to night skylines and natural scenes and rated each as more pleasant than the day skylines" [4]. Photo projective method (PPM) is an experimental aesthetic method in which visitors reflect their environmental connections and aesthetic concerns with photography [5, 6]. This approach can also provide a supportive contribution to skyline studies.

2.1.2 Semantic Differential for Urban Skyline Aesthetic Analyses

Semantic differential is used as a method that includes the ranking of concepts with their opposites in the evaluation of urban aesthetics. "Semantic differential is a method of approximating the effective value that an individual attribute to any phenomenon. This technique is presented in the form of a set of scales selected according to the degree of representativeness compared to the problem under study. Each of these scales is examined in groups that allow the tested person to show both the quality (positive or negative) and intensity of his/her reaction to the phenomenon in question" [7]. Semantic differential measures people's reflections and emotions by rating the scales with the contrasting adjectives [8]. Adjective pairs are used together with the semantic differential method. As an example of adjective pairs depending on aesthetic factors; contrasts such as pleasant/boring, different/habitual, meaningful/meaningless, interesting/not interesting and different/monotonous. Altuntaş and Önder (2016) used a semantic differential scale using adjective pairs for evaluating the urban skylines of Istanbul [9].

2.1.3 Cognitive Studies for Urban Skylines

Generally, in cognitive studies related to urban design, spatial motion and visual environment interactive issues come to mind like cognitive mapping and wayfinding. Cognitive mapping is a construct that encompasses the cognitive process that enables people to acquire, code, store, recall and manipulate information about the nature of the spatial environment. Figure 4 is an example of how the Istanbul Historic Peninsula skyline forms in the mind as a visual in memory. Bostancı and Oral (2017) made experimental research about what kind of a cognitive process is in the perception of urban skylines and how this kind of visual image formed in memory [10]. The aim of this study is to investigate how the image created by the skylines of historical cities can be expressed by drawing. The basic differences between the cognitive mapping techniques and the cognitive perception and the schematic display of a skyline can be discussed through this experimental approach. This study investigated the effects of cognitive features of urban skylines in the visual thinking system" [10]. This is a kind of experimental approach for the evaluation of urban skylines.
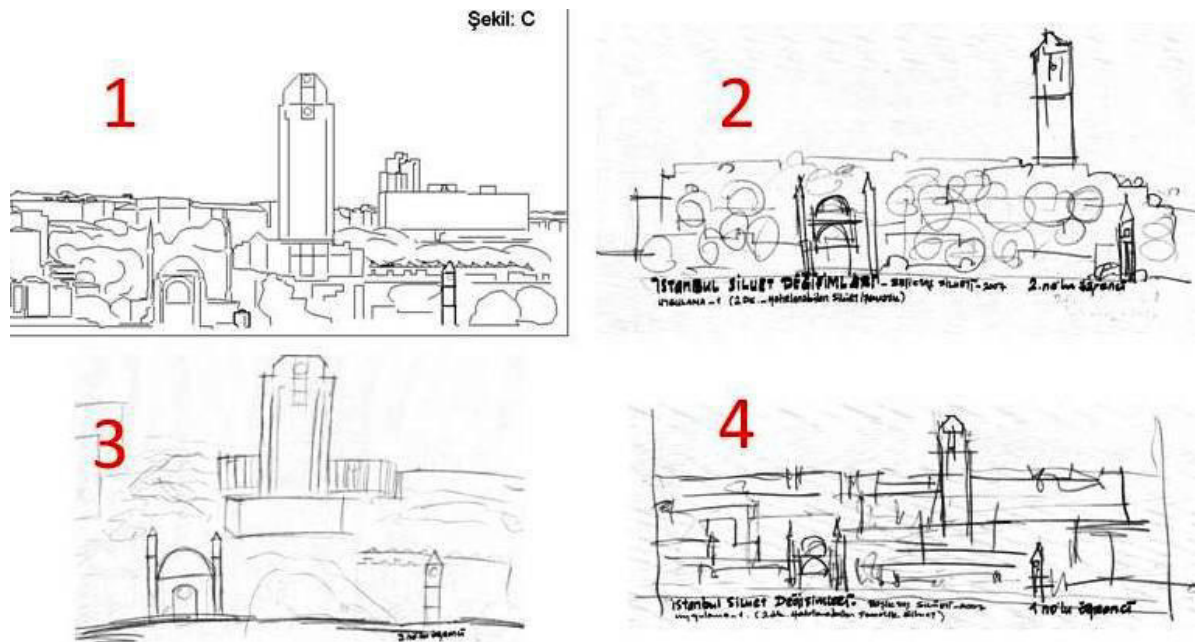

Figure 4. Urban Skyline Sketches [10]

Figure 4 is a part of experimental study made by Bostanci and Oral (2017) [10]. They show videos, skyline photos and skyline drawings to architectural students. And in Figure 4 the first sketch which is numbered as 1 is shown to the students. And 2-3-4 are the skyline sketches of the architectural students they draw what they remembered. These students are living in Konya and the image is from Istanbul. And these drawings show how the dominant structures are remembered as mental images.

There are also some methods depending on neuroaesthetics studies. These approaches are the cognitive neuroscience of aesthetic experience [11]. Neuroaesthetics is related to how the brain affects by the perception of beauty. This is a useful and innovative tool for understanding the human perception of urban skyline aesthetics. Choo et.al. (2017) is the first study that tries to measure how the visuals of special architectural structures create movement in the brain using brain imaging techniques. In this study, neural activity patterns associated with certain architectural styles were found in some high-level visual brain regions, but these effects could not be detected in the primary visual cortex [12]. Naghibi et.al. (2019) examined the effects of architectural features on the brain cortical system with imaging techniques, ERP signals and FMRI activation [13]. Architectural window shapes were found to have a significant effect on the modulation of cortical activity in this study. Similar approaches with these brain imaging techniques can also be carried out over urban skylines.

2.2. Mathematical and Computer Based Studies for Analyzing Aesthetic Quality of Urban Skylines

Today, developments in computer techniques have gone beyond the statistical analysis of questionnaires used in the aesthetic evaluation of urban skylines, and its scope has expanded to include the analysis of different equations on the city form. "Innovative techniques for the visualization and presentation of architecture and more efficient tools for planners and architects have evolved from the current progress in information technology and the improvements in computer hardware and software" [14]. In this section, information entropy, GIS-based approaches, space syntax and skyline analysis on fractal geometry will be examined.

2.2.1 Information Entropy for Evaluation of Urban Skylines

Entropy has two definitions within the fields of probability theory and thermodynamics laws together with statistics. This concept has been first of all used in thermodynamics laws. It has been Clausius (1822-1888) who had realized his studies by being inspired by Carnot's (1796-1832) thermal approach and set forth the name of entropy within the first law of thermodynamics. With relation to random processes, the logarithmic expression of Boltzmann (1844-1906) who have defined the statistical entropy and developed its formula is quite similar to today's information concept on basis of mathematical structure which has been known as communication theory developed by Shannon (1948) [15]. The main problem of communication is that the message selected at a certain point is reproduced approximately or completely at another point. The entropy approach is used in urban studies with various features. Figure 5 groups relevant urban research topics in this area [16].
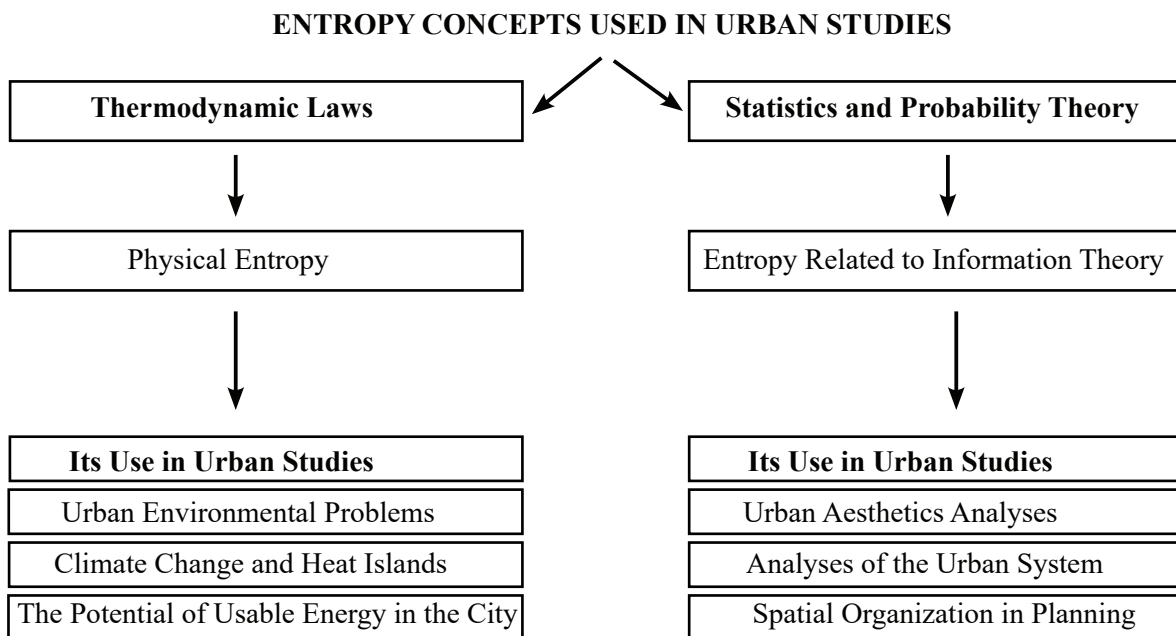
ENTROPY CONCEPTS USED IN URBAN STUDIES

Thermodynamic Laws	**Statistics and Probability Theory**
↓	↓
Physical Entropy	Entropy Related to Information Theory
↓	↓
Its Use in Urban Studies	**Its Use in Urban Studies**
Urban Environmental Problems	Urban Aesthetics Analyses
Climate Change and Heat Islands	Analyses of the Urban System
The Potential of Usable Energy in the City	Spatial Organization in Planning

Figure 5. Using Entropy Concept in Urban Studies

The connection built between entropy and aesthetic has created the concept of information aesthetics [16]. Especially after it became an information criterion with its measurement value within the information theory developed by Shannon, entropy's area of usage has expanded. Consequently, entropy and information theory have been included among the concepts discussed in urban planning and urban development matters. The subject has been used in the visual evaluation and has started to be applied in architectural and urban design scales [17, 18]. Buttar et.al. (1973) have the first study for finding the aesthetic value of historical facades by the information entropy method. In urban design studies, its applications related to aesthetic evaluations of urban skylines are observed [17]. Stamps et.al. (2005) made researches on which building group affected in the cross-section of entropy approach and environmental psychology studies, for

editing urban skylines [19]. Salingaros (2000) made evaluations on the city, architecture and aesthetics using mathematical methods that include information entropy. He investigated the aesthetic appeal of simple textures using mathematical methods [20]. Information theory comprises the mathematical measurement of the information quantity of a message transmitted from a specific source, during the transmission process. Information theory can be approached as a branch of applied probability theory. By redefining entropy in information theory, Shannon has developed the mathematical structure of information theory. Alongside the measurements in the information theory on the aesthetic value of architectural and urban design measurements, Shannon's entropy formula is used [16, 21]. The use of entropy as a concept in different disciplines is also a subject that is criticized. [22]. There are criticisms regarding the use of entropy in the fields of architecture and design [23]. Within this approach, it is necessary to develop studies by considering critical approaches [24]. In such studies, the scope and limitation of the study should be clearly stated. These kinds of innovative approaches allow different interpretations of design contribute to the field.

2.2.2 GIS for Modelling Urban Skylines

GIS (Geographic Information System) is a computer-based system which is capable of integrating data from various sources [25]. This program is useful in urban planning and urban design as well as the other land based disciplines. "GIS techniques generated complementary insights about the spatial and non-spatial factors influencing attitude towards urban areas" [26]. In addition to the production of urban smart maps, GIS-based techniques display buildings in the third dimension. Thus, three-dimensional images of cities such as google earth can be displayed together with their morphology. These techniques are applied with innovative approaches, especially in urban skyline studies on high buildings. Guney at.al. (2012) applied a geo-model in the GIS environment in the aesthetic evaluation of urban skylines. In this study, the Maslak Axis, where high-rise buildings of Istanbul are located, is modelled. And with the study predictions are made for height limitation in buildings for metropolises [27]. The working structure is suitable for testing the skyline effects of future projects. Akdağ and Bostanci (2013) made aesthetic assessment measurement with information entropy over Istanbul skylines modelled with a GIS-based approach [28]. Thus, GIS-based modelling and entropy approach were taken together in the evaluation of urban skylines.

2.2.3 Space Syntax Analyses for Urban Skylines

Space syntax, which is among the objective methods considered in the aesthetic evaluation of the city, is an interactive approach that determines the relationships between external influences that produce forms and social forces [29]. "Space syntax is a research program that investigates the relationship between human societies and space from the perspective of a general theory of the structure of inhabited space in all its diverse forms: buildings, settlements, cities, or even landscapes" [30]. Space syntax, which is among the objective methods considered in the aesthetic evaluation of the city, is an interactive approach that determines the relationships between external influences that produce forms and social forces. "According to the findings of the researches on the subject, it has been determined that the spatial formation alone explains a significant proportion of the change in the total human movement values in different locations in the urban and building interior areas" [31]. When space syntax is associated with different cognitive techniques, it can provide various information on the effects of urban configuration on social life [32]. This method is very useful in pedestrian-friendly urban design studies [33]. Space syntax logic can be used in the current view of the city and also future prediction view of the city [34]. Space syntax studies have been applied in historical areas of Istanbul [35]. Space syntax is also applied to urban GIS studies [36]. Although this study is developed on the interaction with space, it may allow making a certain evaluation on the effects of the urban skylines. Space syntax is basically about citizen mobility experience. For this reason, this method is not very useful in evaluating urban skylines, which are static visual images like photographic views. However, this method can be used as an auxiliary tool in the analysis of the spatial relations of the facades in the evaluation of urban skylines.

2.2.4 Fractal Geometry for Urban Skylines

The foundations of fractal geometry were laid by Mandelbrot in the 1970s. Fractal geometry is different from classical geometry or Euclid [37]. "Fractal shapes are the patterns that are unique to them, repeating on scales from top to bottom so that parts of them at any scale resemble the whole in form. Mandelbrot exemplifies this self-likeness" feature by tearing a piece of cauliflower and points out that this piece itself looks exactly like a small cauliflower" [38]. Fractal geometry applications have recently been paid great

attention in ecology [39]. Fractal geometry is a special area of research in design fields [40]. Taylor (2006) made fractal calculations on the outer contours of urban skylines as a stress-reducing factor [41]. Various computer programs have been developed for fractal dimension measurements and model proposals. Among these, the HarFA program is used to measure the visual richness of images (photographs). HarFA: It means Compatible Fractal Image Analyzer. Visual data are measured according to fractal parameters and numerical values are obtained in fractal terms. With the help of this program, the "Historical Peninsula" coastal silhouette, which can be defined as the silhouette that reveals the historical identity of Istanbul, has been analyzed with this method in order to measure the visual richness of the urban skyline. In this process, the first taken photograph is converted to black and white form. Sharpness and image adjustment are done by the program. After these operations, the program shows the scatter plot and the value for the fractal dimension [42]. Various analyzes are made with fractal geometry in architectural facade evaluations and skyline analyzes [43]. These studies provide opportunities to comment on the visual change processes of cities. Fractal geometry calculates an image numerical value from visuals such as photographs. With this aspect, it calculates visual dimensions such as skyline. However, it cannot provide sufficient data for a holistic aesthetic evaluation based on separate data of design criteria. This method can be used as an auxiliary tool in evaluating the urban skylines.

3. INTEGRATION OF THE METHODS FOR URBAN SKYLINE ANALYSES

The research design of the study was formed by the ideas of the current studies seen in Table 1. This information also formed the basis for the groupings and the development of the model. From this point of view, this study is a synthesis of various researches carried out by the author in the period 2008-2019, in which more than fifty urban skylines are analyzed. An integrated model has been created by combining these methods for the evaluation of urban skylines.

Table 1. Ideas of the works carried out by the author that develops the infrastructure of the model.

Authors and Year	The Name of The Article	Explanation
Bostancı (2008)	Evaluation of the urban skylines by the entropy approach (Ph.D. Thesis)	The study, which analyzed 50 images in the aesthetic evaluation of city silhouettes, was carried out with the information entropy approach. This Ph.D. thesis also includes preliminary research knowledge of the methods explained in the study. In this respect, it forms the basis of the model.
Bostancı and Ocakçı (2011)	Innovative approach to aesthetic evaluation based on entropy	In the study, in which urban skylines were compared with Istanbul examples, information entropy-based analyses were made.
Akdağ and Bostanci (2013)	The Impacts of prestige projects on the skyline of Istanbul	This study has a unique content in which the GIS model and information entropy approach are integrated over the skylines of Istanbul. It provided an important input in the development of the model.
Bostanci, and Oral (2017)	Experimental approach on the cognitive perception of historical urban skyline	This study includes cognitive studies for urban skylines with an experimental approach. Semantic differential is used for testing the results.
Bostanci (2019)	Critical thinking about urban studies linked with thermodynamic terms	The approach in this study, which includes criticisms of numerical studies such as information entropy, contributed to the creation of the details of the model, especially in the selection of the image to be analyzed.

Table 1 provided data for the formation of the model developed in this study. Figure 6 shows the model developed by this study.
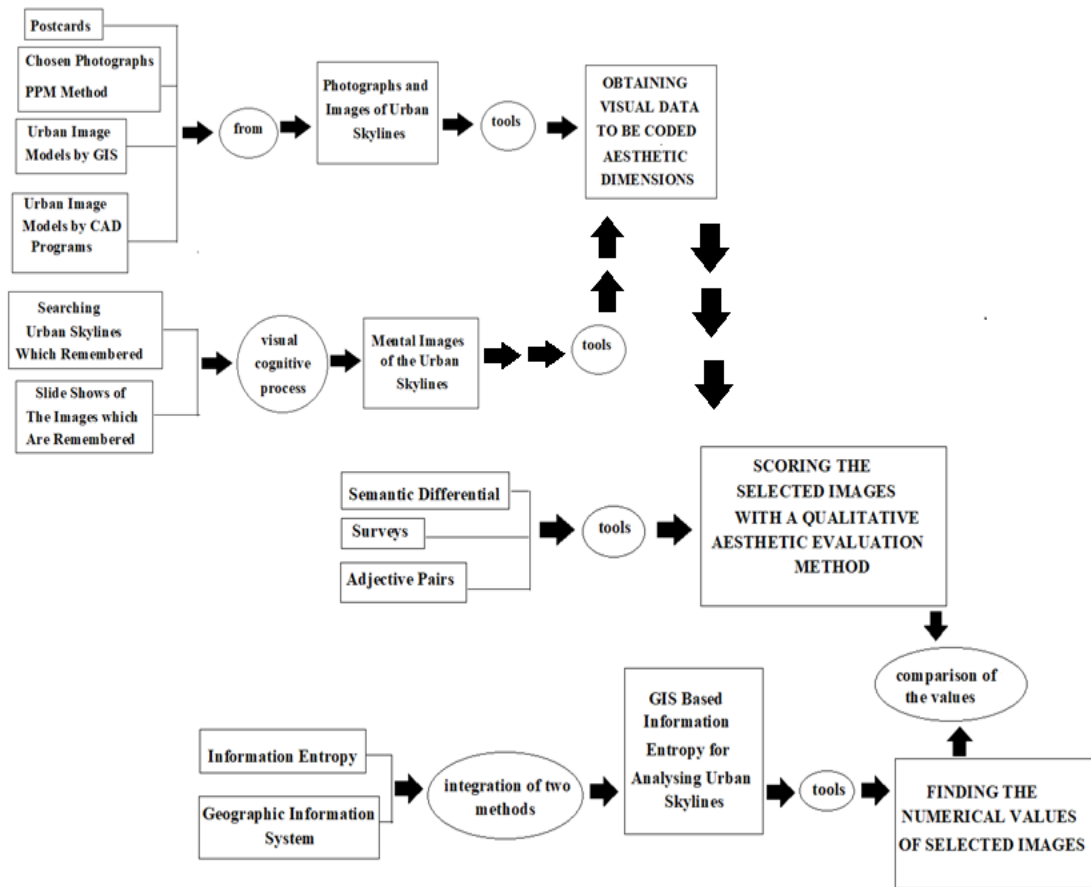

Figure 6. Integrated Aesthetic Evaluation Model for Urban Skyline Analyses (Drawn by Author).

The model seen in Figure 6 can be applied over two different areas in urban design. One of these fields is formal aesthetic evaluation, and the other is environmental psychology. The distinction between them shows two separate paths to the "obtaining visual data to be codded aesthetic dimensions. The acquisition of images with photography and computer techniques makes the study a subject of formal aesthetic evaluation. Here, visual data are obtained in four ways. These are photographs taken with PPM method, postcards, modelling urban images with computer based visualizing programs like GIS and CAD programs. In this way, visual data obtained in more objective ways obtain aesthetic value with the entropy method of GIS based information, and these values are tested by comparing them with the scoring in qualitative methods in the model.

If an urban skyline assessment is to be made on environmental psychology, the visual perception and cognitive process of the observer should be monitored. At this stage, the second way is applied in the production of visual data. Here, visual data is obtained by drawing a skyline image remembered by the participants. Thus, some of them are obtained by showing them visually and drawing what they remember or some of them are obtained by asking them to draw the skyline that they remembered in the city they live in. Since this kind of visual data also requires the ability to draw, it is more appropriate for students from architecture faculties to be participants in this experimental study. Nevertheless, if a control group far from the design areas contribute to the experiment, some information about the most remembered buildings of the city can be obtained. A detailed applied research on this subject can be seen in the study of Bostanci and Oral (2017)

[10]. Again, with this approach, visual data is obtained through sketches. And this data is processed with GIS-based information entropy method for its numerical aesthetic value. The aesthetic value data in bits obtained from the findings can be compared with scoring in qualitative methods.

4. CONCLUSION

In this study, an approach that evaluates the aesthetics of skylines in the context of urban design has been developed. There are different descriptive and applied studies in urban conservation and urban history and urban identity studies. The skyline evaluations can be added to these studies. Interdisciplinary approaches can increase the scientific depth of these studies. Urban skylines provide various information about the historical background of the cities, their political understanding, cultural texture, their position in the global system, their economic potential, belief systems, and their sociological characteristics. Thus, there are various topics that can be explored for researchers interested with urban skylines.

The studies examining the urban skylines throughout this research, many publications dealing with Istanbul were encountered. Skylines of Istanbul offers researchers a wide variety of visual boards such as historical panoramas, mass housing areas, chaotic topography and high-rise buildings showing the global vision of the metropolis. Depicting what remains in his mind as a result of examining a city from a helicopter with her panoramic memory, Stephen Wiltshire also chose Istanbul in this field of study [44]. Some new subjects will also bring approaches to skyline studies in the near future such as how people handle urban skylines as social media sharing images and which skylines are scanned more in computer searches.

As a result of this study, a unique urban skyline aesthetic evaluation model shown in Figure 6 has been obtained. This model is also a synthesis of the studies shown in Table 1. This model can be developed in future studies with different data processing methods such as machine learning and big data. However, all these methods can be considered as intermediate methods in finding the aesthetic values of urban skylines in terms of bits using information entropy method. This study suggested information entropy as a unifying method for urban skylines. Although some of studies seen in Table 1 are used images from different cities, the author has included Istanbul skylines in her all these works. The common point of these studies is that they emphasize the importance of preserving the Historical Peninsula, which is the unique skyline for Istanbul. From the first study of Buttar et.al. (1973) to Bostancı (2008) information entropy method highlights that the historical urban skylines are more valuable than modernist and high rise buildings in their aesthetic qualities. Because historical facades of the skylines have more visual information than modernist building facades.

In the field of urban design, new approaches and methods that can develop creative perspectives are sought. In this quest, computer sciences, physics, environmental psychology, sociology and many other fields are examined for new approaches by establishing connections with urban design issues. Studies on urban skylines provide important information on the transformation processes of cities. In this process, various drawbacks of applying and interpreting methods created by using the fields of engineering sciences and physics in urban design may arise. Generally, as discussed here in method processes, numerical models of a visual scene can be produced with various techniques. How to interpret the obtained data is the hard part of these kinds of researches. For example, sometimes design elements and their features can be defined by metaphors. However, this uncertainty can be resolved by the joint discussions of experts in the fields of science and design, as it allows more interdisciplinary studies today. But experts in technical sciences, especially engineering, are not willing to participate in studies in these fields of art and architecture. They may worry that their scientific stance will be questioned. This situation varies by country. For this reason, a situation may arise for designers to consult technical experts but not always work with them. Scientific achievements of interdisciplinary studies become more and more important every year, as long as they are not detached from their context and main purpose. One of the effects of these interdisciplinary studies is that the researches create an opportunity to attract more attention of the public.

This study has shown various approaches exist regarding urban skylines that can only be considered as the symbolic image of a city. Benefiting from the models mentioned here in order to protect the skylines in the historical and new development areas in the aesthetic boards of the municipalities can produce very effective results. So urban skyline effects evaluated and modelled for future constructions before a project is realized. This could be an opportunity for early intervention for protecting valuable urban skylines.

Such an integrated urban skyline evaluation model can help architecture faculty students to understand urban morphology in a different way. The model developed in this study (Figure 6) can contribute to urban design and architecture students' evaluation of urban aesthetics. So this it makes them thought about although some buildings have interesting designs, if they cannot establish the right relationships with the city's harmony, they cannot leave a good legacy for the city. It is important for the future of cities to be able to protect the skylines of historical cities in a holistic way. This important subject can be proposed as an elective course called "urban skylines" in architecture and urban planning education by improving its contents. At the same time, this method contributes to the pre-evaluation of professionals. Local governments can preserve the aesthetic values of their cities by taking advantage of this model.

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