MAKÜ BBBF
BUCAK BİLGİSAYAR VE BİLİŞİM FAKÜLTESİ

Scientific Journal of Mehmet Akif Ersoy University, 2024, 7(2), Page:109-116

Research Article

Using Musical Notes and Artificial Intelligence Together as a Tool in Spatial Design

Hüseyin Samet AŞIKKUTLU[1*], Latif Gürkan KAYA[1], Betül Halime UZUNAY[2]

[1] *Department of Landscape Architecture, Burdur Mehmet Akif Ersoy University*

[2] *Department of Design, Burdur Mehmet Akif Ersoy University*

ABSTRACT

It is possible to state that it is an important issue to follow different methods or current issues in revealing spatial design approaches. Thus, it will be possible to create spaces with unique and remarkable qualities. Music can be a tool that can be used or utilized in spatial design processes. The aim of this study is to explore the outcomes of combining musical notes and artificial intelligence to develop suggestions and alternatives for spatial design. The material of the study consists of national and international literature on the subject, a song sample selected specifically for the subject, AutoCAD, 3ds Max, Corona Renderer programs and PromeAI artificial intelligence program. In this context, three-dimensional visuals were created using computer programs based on the notes and sound waves of the selected song and alternatives based on these visuals were put forward. As a result, it is possible to state that the use of musical notes together with computer and artificial intelligence programs will be effective for designers to reveal faster, remarkable and innovative spatial design approaches.

Keywords: Artificial intelligence, Music, Note, Space, Spatial design.

1. INTRODUCTION

Music, which has an important place in human life [1], is both a translator of emotions and a powerful structure that can affect every aspect of our lives [2,3]. Therefore, music has interacted with many branches of art and is structurally associated with the concept of time and existentially associated with the concept of space. Music can be used to determine the form in design, and it is possible to create space in line with the data obtained from music. In this context, it can be stated that music can be included in the space and even conceptually evaluated and the space can be organized [4].

In the 6th century BC, Ancient Greek philosopher Pythagoras introduced the Theory of the Music of the Spheres, connecting music and arithmetic to achieve perfect harmony, which he described as the ultimate standard of absolute harmony. Pythagoras discovered that musical notes could be spatially interpreted by vibrating two strings of proportional size under the same conditions. If the strings are in a 1:2 ratio (diapason), the shorter string produces a note one octave higher than the longer one. When the strings are related in a ratio of 2:3 (diapente), the difference in height corresponds to one fifth. When the ratio is 3:4 (diatessaron), there is a difference of a quarter. Thus, the harmonies of the Greek musical system are expressed in the sequence 1:2-2:3-3:4, which is composed of the first four integers believed to determine the secret of the ideal harmony that reigns in the universe [5]. Pythagoras is said to have realized that when he heard the rhythmic sounds made by blacksmiths striking the anvil with hammers, he realized that these strikes were in a numerical and geometric order. This leads to the idea that the microcosm and macrocosm of the universe may have the same harmonic principles. According to him, the universe actually shows an ideal order of sounds. The intervals in music express a structural reflection of the universe. The interval of each note is proportional to the absolute orbital distances of the planets, and this works in harmony with the sounds that reach a human ear. According to Pythagoras, nature is manifested in the microcosm and the human body is organized in perfect proportions. These Pythagoras' ideas and traditions are still alive today [6].

***Corresponding Author Email:** sasikkutlu@mehmetakif.edu.tr
Submitted: 30.10.2024 **Revision Requested:** 21.11.2024 **Last Revision Received:** 27.11.2024
Accepted: 27.11.2024 **Published Online:** 05.12.2024

Burdur Mehmet Akif Ersoy University Press

Cite this article as: Aşıkkutlu, H.S., Kaya, L.G., Uzunay, B.H. (2024). Using Musical Notes and Artificial Intelligence Together as a Tool in Spatial Design. Scientific Journal of Mehmet Akif Ersoy University, 7(2): 109-116.
DOI: https://doi.org/10.70030/sjmakeu.1576148

https://dergipark.org.tr/sjmakeu

Regarding the use of musical notes in spatial design processes, Egido Jiménez [7] stated in his study that Chartres Notre Dame Cathedral is in perfect harmony in terms of its dimensions and proportions and that it is shapely representative. He also stated that the building was constructed with a musical proportion hidden in the floor plan and the geometry of the west facade. Figure 1 presents visuals of the facade views and floor plan of Chartres Notre Dame Cathedral.

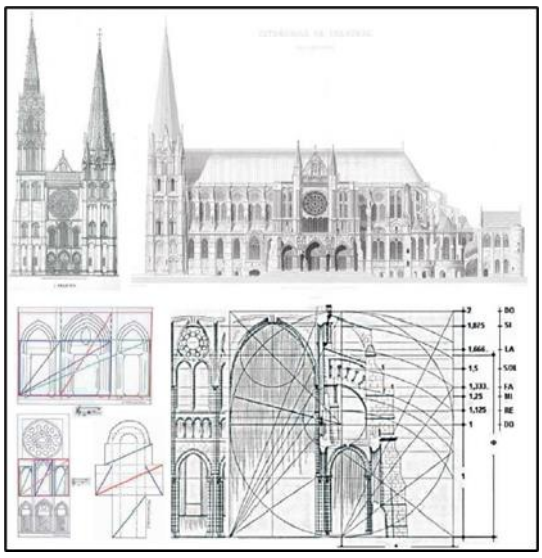


Fig 1. Visuals of the facade views and floor plan of Chartres Notre Dame Cathedral [7]

In a different vein, Egido Jiménez [7] stated in his study that Villa Foscari is an important example of the use of musical proportions and numerical values in space design. He also emphasized that the harmony of spatial proportions and music is seen in the floor plan and facade of the building. In Figure 2, visuals of Villa Foscari's facade views and floor plan are presented.

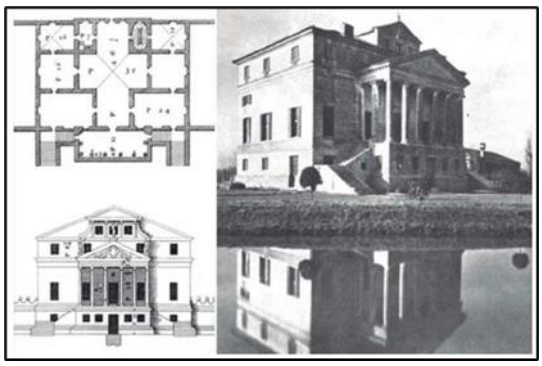


Fig 2. Visuals of Villa Foscari's facade views and floor plan [7]

The Stretto House is a building consisting of four sections and is another example of music transformed into a home form based on string and percussion instruments [8]. Figure 3 presents a visual of the design of the Stretto House.

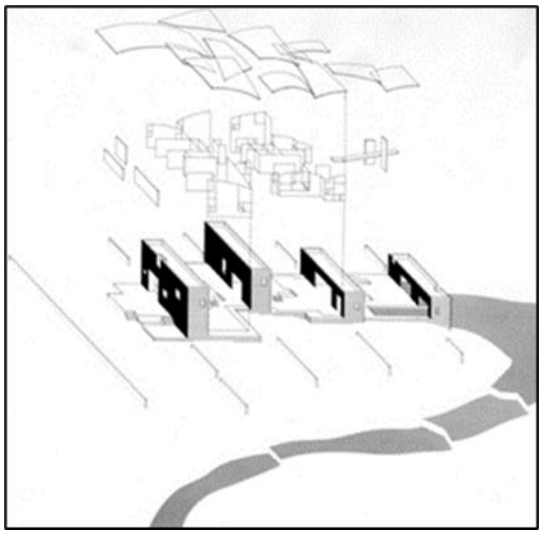


Fig 3. Visual of Stretto House's design [8]

Artificial Intelligence (AI) is defined as the intelligence exhibited by an artificial entity to solve complex problems, and such a system is generally assumed to be a computer or machine. AI represents the integration of computer science and physiology. In simple terms, AI is concerned with making computers behave like humans and do so in a much shorter time [9]. In a different assessment, as a branch of science that enables computers to imitate human behavior to help humans to perform better in science and technology, the main goals of AI are to replicate human intelligence, solve knowledge-intensive tasks, build machines that can perform tasks that require human intelligence, and create a self-learning system [10].

In recent years, AI has been increasingly used in the field of spatial design as in many other fields. This means that designers should use AI in the design process [11]. The relationship between AI and space design can be applied in many different fields. By analyzing concepts in the design process, it can constrain or expand design alternatives. However, AI has the potential to automate human-intensive tasks in the design process, which can speed up the design process. It can analyze the data used in space design and use this data to improve the functionality and aesthetics of the space [12]. In short, AI, which is a comprehensive interdisciplinary science field, can produce effective solutions to spatial problems [13]. As a result of the use of AI technologies in space design, the need for manpower decreases and it can be said that the studies are realized with full efficiency [14]. Another way of using AI in space design is to optimize space. By analyzing the data used to optimize the space, AI can offer suggestions that will ensure the best use of the space. For example, AI can increase the functionality of the space by suggesting the most appropriate arrangement according to the intended use of the space [15].

The aim of this study is to create three-dimensional alternatives based on spatial design by using musical notes and AI together and also to put forward suggestions for the use of musical notes in spatial design processes with AI support.

2. MATERIALS AND METHODS

The materials for this study include national and international literature on the subject as well as the song 'And She Was' by the Talking Heads. In addition, AutoCAD, 3ds Max, Corona Renderer programs and PromeAI as an AI program constitute the material of the study.

The methodology of the study consists of two stages. In the first stage, it was aimed to develop three-dimensional spatial design visuals. For this purpose, it was inspired by the song “And She Was” by the band “Talking Heads”, which Martin Wattenberg used to analyze music in a visual format in his work “The Shape of Song”. First of all, the visual situation of the colors and shapes of the song was drawn in two dimensions in AutoCAD program. Different plans were obtained by removing some parts of this design. These plans, created by preserving the proportions in the first figure, were transferred to the 3ds Max program. No function was defined for the forms modeled in the 3ds Max program. Finally, their renderings were taken with the Corona Renderer program used as an add-on to the 3ds Max program. In

the second stage, various functions were defined and visuals were created for these forms through PromeAI as an AI program.

3. RESULTS AND DISCUSSION

Martin Wattenberg, a studio musician and data visualization expert, began his 2001 work "The Shape of Song" with the aim of seeing the form of music. In his work, he used a visualization method called arc diagram, which shows the repeated sections of music or any sequence with translucent arc drawings. In this context, Martin Wattenberg analyzed many pieces of music in a visual format, and one of the examples he examined was the song "And She Was" by the band "Talking Heads" (Figure 4) [16].

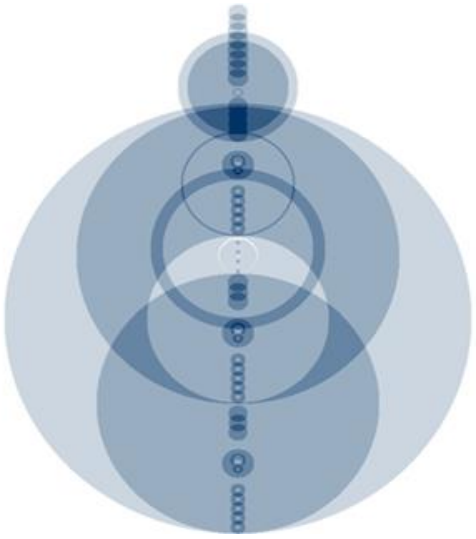


Fig 4. Visualized version of "And She Was", the song of the group "Talking Heads" [16]

In his work, Martin Wattenberg seeks to visually interpret the experience of listening to music. The visual representation of each song presents the melodic and instrumental structures of the song through different colors and forms. This allows listeners to visually explore the song's structure, rhythm and the interaction of the instruments [17].

The visual of the song "And She Was" of the "Talking Heads" group, which Martin Wattenberg used in his "The Shape of Song" study, drawn in two dimensions in AutoCAD program is presented in Figure 5.

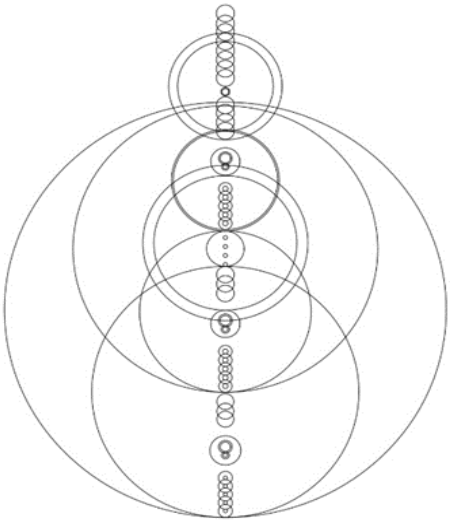


Fig 5. Figure of the two-dimensional drawing of the song "And She Was" by the band "Talking Heads" in AutoCAD program

The dense lines and forms in this figure were then simplified before moving on to the form phase. Some lines indicate elevation differences, while others define the ceiling element (Figure 6).

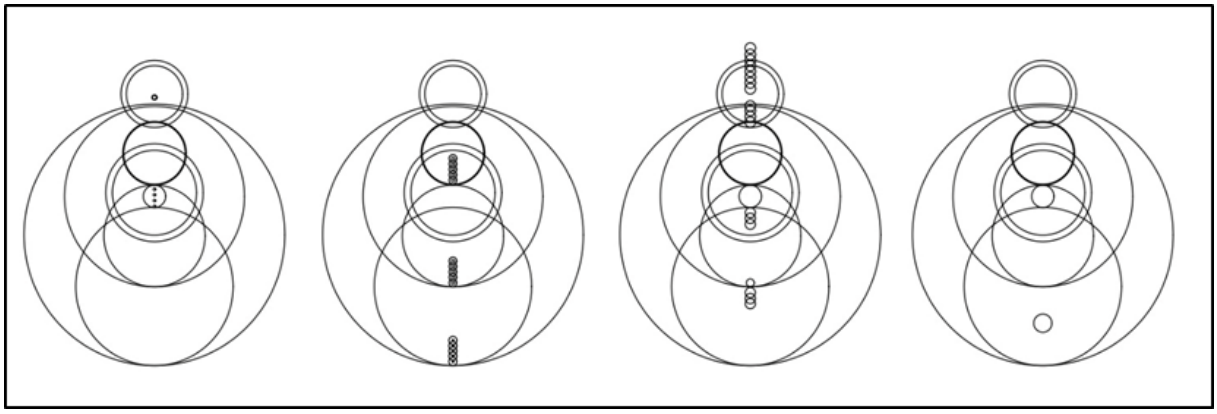
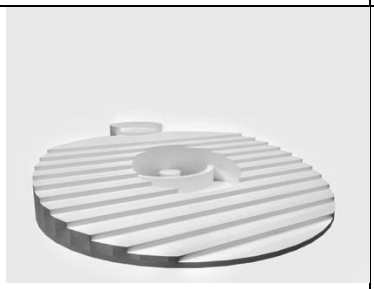
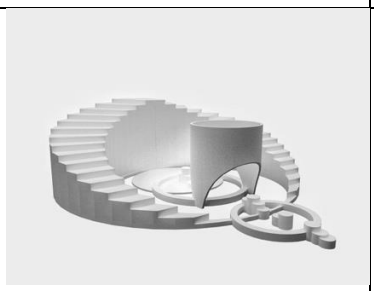
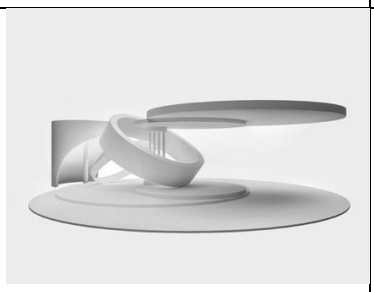
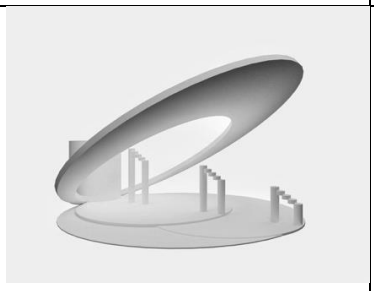
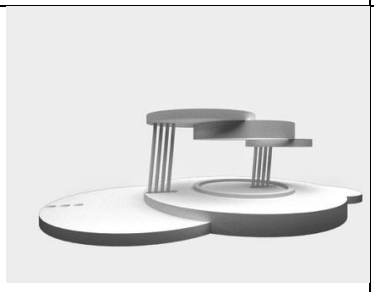
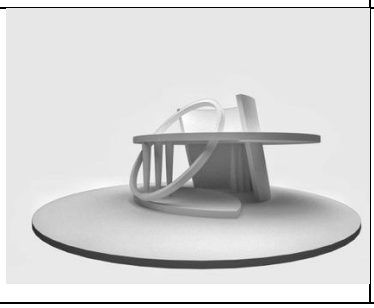
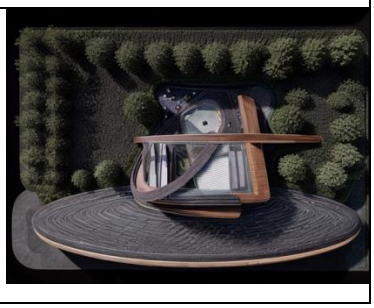


Fig 6. Simplified version of the figure transferred to AutoCAD program

Various forms were created using the 3ds Max program and using these lines. The visuals of the forms were rendered with the Corona Renderer program. Finally, various functional approaches to these forms were selected in the AI program PromeAI to make it a more aesthetic and usable space. In Figure 7, the visuals produced for the concretization and interpretation of the abstract structure of the musical notes of the song “And She Was” are presented and the design approaches of these visuals are explained below:

- A stepped roof garden design was created by perceiving the model created in Figure 7a-a1 as a top view. AI evaluated the space created in the middle section as a water element. The model created in Figure 7a-a2 was intended to be an amphitheater design. This amphitheater design, which was placed in the garden of a house with the help of AI, can also be evaluated in a square at a larger scale.
- The model created in Figure 7b expresses an accentuating space created by integrating with the water element. While Figure 7b-a2 is located completely in the center of the water element, in Figure 7b-a1, it is positioned on the edge of the water element and plant elements and an ornamental pool are integrated into it, offering users the opportunity to experience this monument.
- While Figure 7c-a1 can be considered as an accentuating space or square, Figure 7c-a2 has been completely transformed into an architectural structure. The staggered placement of the cylindrical forms has made the architectural structure more effective.
- The model created in Figure 7d-a1 is perceived as a plan and an architectural form or an example of an urban park is revealed. The part seen as wooden veneer can refer to an architectural element, and if this area is considered as a city park, it can also be evaluated as a skateboard track. Figure 7d-a2 perceives the form as three-dimensional and associates it with skyscrapers and evaluates it as a monument in a city with skyscrapers.
- Figure 7e-a1 is interpreted as an area enriched with plant elements within the park area. On the other hand, the form in Figure 7e-a2 is interpreted as a kitchen unit in a completely different context, which shows that the resulting form is versatile and functional.
- In Figure 7f-a1, the form has been transformed into an independent and small space. In this form, an image that can be evaluated as a tiny house, a security hut, a coffee sales unit or a villa entrance unit is provided. Figure 7f-a2 shows the top view of a building unit since it is preferred to evaluate the form as a top view. This view can belong to a restaurant or a detached building.
- Figure 7g was asked to be evaluated in the interior space and different materials and styles were experimented on this form. While a modern image was created with wooden materials in Figure 7g-a1, Figure 7g-a2 was given an industrial appearance with metal materials.
- Figure 7h-a1 expresses a form that can be integrated into children's playgrounds, while Figure 7h-a2 expresses a Moroccan and Marrakech style interior.
- In Figure 7i-a1, an accentuating element is created, while in Figure 7i-a2 the same form is used as an information desk.

	Created Model	Alternative 1 (a1)	Alternative 2 (a2)
Figure 7a			
Figure 7b			
Figure 7c			
Figure 7d			
Figure 7e			
Figure 7f			

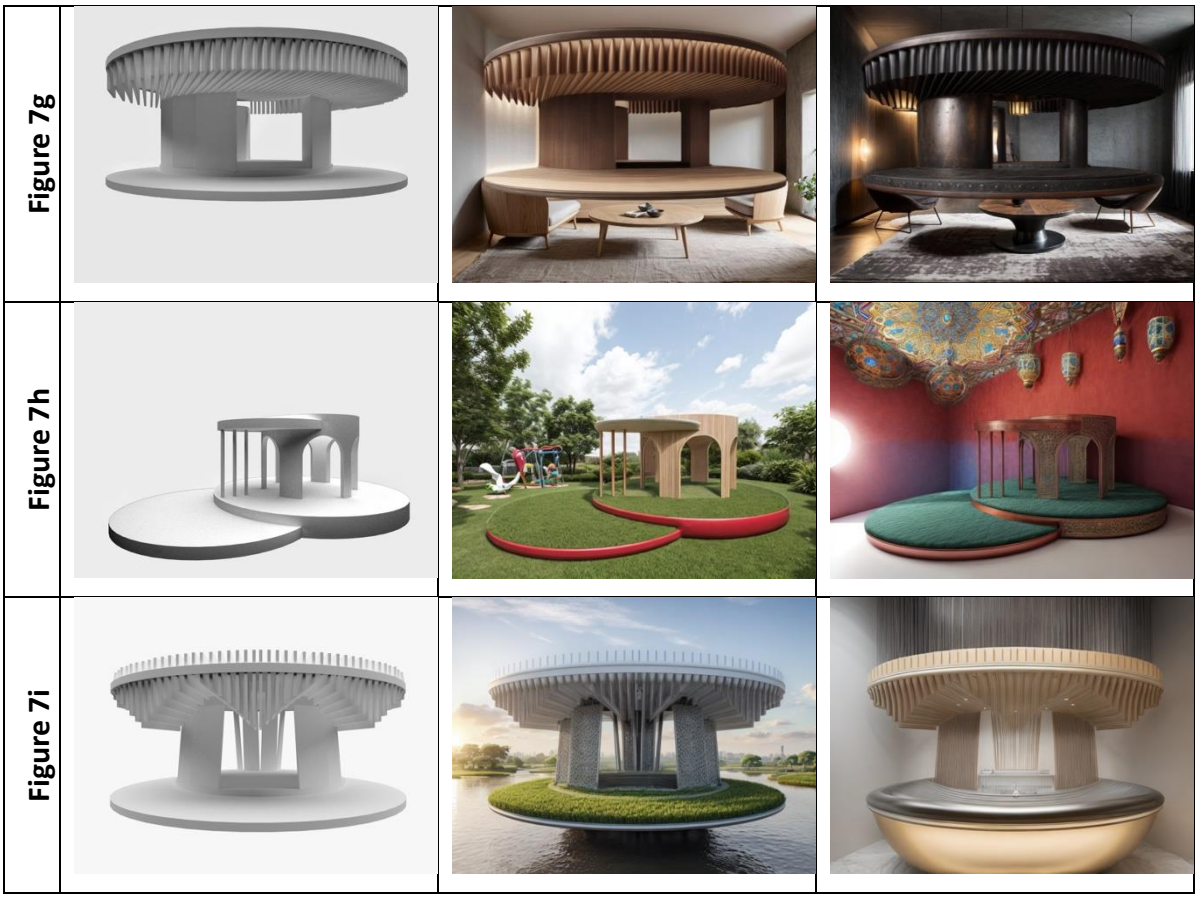


Fig 7. Figures of the approaches in which the forms were functionalized with the AI program PromeAI within the scope of the study

4. CONCLUSIONS

Music and AI can be used together to create concepts and alternatives in spatial design approaches. In this context, suggestions on the contribution of music to the spatial design process are presented below:

- After examining the selected music piece or notes, the emotions and atmosphere expressed by the music can be reflected in the interior and exterior design using AI programs by considering elements such as tempo, rhythm, tone, harmony.
- The tones and rhythm of the music can determine the color scheme and lighting of the space. A lively and energetic piece of music can be associated with bright colors and dynamic lighting, while a softer and more emotional piece of music can be paired with colors that have calmer and softer tones. This can be made more emphatic through AI programs.
- The rhythm and flow of a piece of music can influence the layout of the space. For example, the rhythmic structure of the music can be a guide in determining the furniture layout or circulation routes within the space. Therefore, using AI programs can create a more remarkable space design.
- The tones of the instruments or notes in the music track can be a source of inspiration in the selection of materials to be used for the space. Thus, it can be stated that the emotions given by the music track can affect the overall feeling of the space when supported by AI programs.

It can be stated that as a result of the use of AI, which is used in many fields today, together with music in spatial design processes, many alternatives with faster and different features can be developed. AI, which is a current issue, can be considered as an approach that will enable the designer to reveal approaches at different scales and in different concepts. In conclusion, integrating AI and music offers the potential to develop innovative and practical approaches to spatial design.

ORCID

Hüseyin Samet AŞIKKUTLU https://orcid.org/0000-0002-3518-7202
Latif Gürkan KAYA https://orcid.org/0000-0001-8033-1480
Betül Halime UZUNAY https://orcid.org/0000-0002-1007-6389

REFERENCES

[1]. Welch, G.F., Biasutti, M., MacRitchie, J., McPherson, G.E., & Himonides, E. (2020). Editorial: the impact of music on human development and well-being. Frontiers in Psychology, 11, 1246. DOI: 10.3389/fpsyg.2020.01246
[2]. Sloboda, J.A. (2010). Music in everyday life: the role of emotions. Juslin, P.N., Sloboda, J.A. (eds.), In Handbook of Music and Emotion: Theory, Research, Applications, (pp. 493–514). Oxford University Press.
[3]. İmik, Ü., & Haşhaş, S. (2020). What is music and where is it in our lives. İnönü University Journal of Culture and Art, 6(2), 196-202.
[4]. Ölgen, B., & Öztürk, Ö.B. (2019). Tasarım ve müzik ilişkisinin mekândaki izdüşümü. Sanat ve Tasarım Dergisi, 24, 301-319.
[5]. Clerc González, G. (2003). La arquitectura es música congelada. (Doctoral dissertation), Escuela Técnica Superior De Arquitectura De Madrid, (10.08.2024). Retrieved from https://oa.upm.es/268/.
[6]. Yılmaz, Y. (2008). An approach to generate form in the intersection of music and architecture. (Master's dissertation), İstanbul Technical University.
[7]. Egido Jiménez, H. (2017). Del tiempo al espacio. Diccionario Gráfico Comparado Entre Música y Arquitectura. Trabajo Fin de Grado. ETSAM: Escuela Técnica Superior de Arquitectura de Madrid, (10.05.2024). Retrieved from https://oa.upm.es/50857/.
[8]. Stretto House, (05.09.2024). Retrieved from https://www.architectmagazine.com/project-gallery/stretto-house-506.
[9]. Borana, J. (2016). Applications of artificial intelligence & associated technologies. Proceeding of International Conference on Emerging Technologies in Engineering, Biomedical, Management and Science [ETEBMS-2016], 5-6 March 2016. Jodhpur, India, pp. 64-67.
[10]. Ghosh, M., & Thirugnanam, A. (2021). Introduction to artificial intelligence. Srinivasa, K.G., Siddesh, G. M., Mani Sekhar, S.R. (eds.), In Artificial Intelligence for Information Management: A Healthcare Perspective. Studies in Big Data, vol 88. Springer, Singapore. pp. 23-44. DOI: 10.1007/978-981-16-0415-7_2
[11]. Lukovich, T. (2023). Artificial intelligence and architecture towards a new paradigm. YBL Journal of Built Environment, 8(1), 30-45.
[12]. Gelişen Tasarım: Yapay Zekâ ile Mekân Yerleşimi Üretimi, (06.09.2024). Retrieved from https://xxi.com.tr/i/gelisen-tasarim-yapay-zekâ-ile-mekân-yerlesimi-uretimi.
[13]. Tazefidan, C., Eşme, E., & Başar, M.E. (2022). A Literature Study on the Use of Artificial Intellingence Applications in the Field of Architecture. International Congress on Art and Design Research. Art & Design-2022 Book of Proceedings, 20-21 June 2022. Kayseri, Türkiye, pp. 986-1002.
[14]. Yıldırım, B., & Demirarslan, D. (2020). Evaluation of the benefits of artificial intelligence applications to the design process in interior architecture. Humanities Sciences (NWSAHS), 15(2), 62-80. DOI: 10.12739/NWSA.2020.15.2.4C0236.
[15]. Bayrak, E. (2022). Evaluation of artificial intelligance and space design interaction in today's design education, (Master's dissertation), Hacettepe University.
[16]. The Shape of Song, (05.09.2024). Retrieved from https://www.bewitched.com/song.html.
[17]. Wattenberg, M. (2002). Arc diagrams: visualizing structure in strings. IEEE Symposium on Information Visualization, 2002, INFOVIS 2002, 28-29 October 2002. Boston, MA, USA, pp. 110-116.