International Journal of Applied Arts Studies

Volume 10, Issue 1

February – March 2025

Islamic Azad University, Yazd Branch, Iran

Acknowledgement

IJAPAS would like to thank the following people for their contributions in this volume.

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In the Name of God

Dear Readers,

I, on behalf of the editorial board, am proud to present this issue of the *International Journal of Applied Arts Studies (IJAPAS)* under the sponsorship of the Islamic Azad University, Yazd Branch. We were driven to found the *IJAPAS* by a noticeable lack of journals, in the Islamic Republic of Iran in particular, devoted to architecture, urban design, urban planning, architectural conservation and restoration, painting, art history, graphic, digital arts, fashion design, performing art, industrial design, aesthetics and semantics. Although the academic world is increasingly driven by cross-disciplinary visions and models, we seek multi-disciplinary views, an attempt to inform researchers, graduate students, and professionals about the trends, ideas and innovations being put forward in applied arts. To this end, in addition to standard articles, in every volume of the *IJAPAS* we hope to provide a special issue related to a respective field with innovation.

We are also sending out a call for papers related to *Applied Arts* to appear in the next issue of *IJAPAS* in May – Jun 2025.

Finally, I should mention that we are committed to a speedy refereeing process for every article submitted to us. We effort to reply to all papers submitted within five weeks' time with a response about acceptance or rejection. We also do not require formatting for submissions in our style until *after* the paper has been accepted by us for publication.

I would like to thank our Editorial Board for their work so far in helping to establish the *IJAPAS*. And, finally, I would like to extend my deepest gratitude to Dr. Ali Boloor, the assistant editor of the *IJAPAS*, for all of his hard work to ensure the timely completion of the issue.

I am delighted to invite you to visit us at www.ijapas.org.

Sincerely,

Dr. Abolfazl Davodi Roknabadi
Editor-in-Chief
International Journal of Applied Arts Studies (IJAPAS)
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Studying the Obstacles of the Formation of Interactive Architecture Emphasizing at Virtual Reality Technology in Tabriz, Iran

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Article Info	ABSTRACT
	For a long time, in the process of architectural design, mutual understanding between designers and users has always had problems and dilemmas, and most of these obstacles and problems were due to the lack of suitable interactive and communication tools and facilities. Therefore, it is necessary to use the inherent ability and potential of virtual reality technology in order to establish interactions and mutual and two-way communication. The present research has been carried out to investigate about the principal obstacles in the formation of interactive architecture emphasizing at the use of virtual reality technology. Considering the importance of technology in architecture, the purpose of this research is to evaluate the basic shortcomings in the formation of interactive architecture and the promotion of human interactions, emphasizing the benefit of virtual reality technology. The research method in the present research is mixed (quantitative-qualitative) with practical purpose and analytical-exploratory nature, in order to analyze the information, partial least squares model was used in Warp-pls software. The findings of the research show that among the basic obstacles of the formation of interactive architecture with an emphasis on virtual reality technology, we can point out the lack of attention to architectural contexts, the lack of attention to identity building goals and the lack of complementary interaction between architecture and nature. Therefore, in order to realize interactive architecture, to improve human interactions and also to increase the sense of belonging to the place of application of virtual reality technology in all kinds of architectural designs, taking into account the design fields, it is necessary to create a relative balance between all factors and pay attention to the development in the future.

Introduction

Interactive architecture deals with designing and construction of spaces that adjust with changing needs and conditions of individuals, surrounding environment, and the society they live in the exchange of data between two systems (two humans, two machines, a human and a machine) is known as the basic principle in an interaction (Boychenko, 2019). The major point regarding interactive architecture is the fact that the interaction between them should be in the form of a cycle, or else the interaction would not happen and solely there would be a reaction (Fox, 2010). An interactive system is a multiple loop system that involves a person in a conversation, a type of communication which entails constructive and consecutive data exchanges. These systems are dynamic systems through which the data are constantly exchanged, the environment and the system are affected by each other all the time, and the responses are not pre-determined. Such a system is able to promote outputs throughout the time and through the interaction and complete relationship with inputs received from the environment. On the other hand, interactive architecture not only is able to respond the preplanned requirements, but also can enhance humane interactions and can introduce culture and art and architecture to all over the world and enables its users to have a flexible role in forming the environment (Liang et al., 2021). This means that an interaction happens between human beings and environment in interactive architecture. Also, through understanding the approaches and origins of interactive architecture we can conclude that this specific type of architecture designs electronic and virtual terminals to create spaces through which a two-way interaction between human beings and architecture is established (Sutny et al., 2019). Furthermore, it should be noted that in interactive architecture, the interactions between humans and accessibility of the target and the major identity of the design are considered and the interactions between the inhabitants and the technology promotions are known as the key points in success of architectural spaces (Stanica et al., 2018). Therefore, it could be stated that technology known as a tool to achieve desirable goals has tremendously changed the conception method of individuals of the world, and the type of relationship between them and the lifestyles and it has affected the different aspects of human life in a way that some believe that human beings and the world would be dominated by technology in a near future (Telma and Pacheco, 2009). In a more limited scale and in architecture which is an interdisciplinary scientific field, an interference of technology regarding the dependency of architecture to material world and thus observing natural principles becomes necessary. In a first glance, technology is considered as a machinery but if we do deep into the topics revolving around it, it can be revealed that this concept entails a vaster range through which in architecture there exist theoretical fundamentals, thoughts and designing processes, instruments and tools, machinery and finally the ending effect (human interactions) (Knox, 2017).

Thus, in the present era, using technology and virtual reality system have introduced a novel logic within architecture that could be tangible regarding current advances and the current era advances have been very prevalent and have resulted in developing interactive architecture. Meanwhile, although the boundaries between reality in the world and the effect of technology in interactive architecture have been changed, we cannot observe a fundamental thought change trend in Iran regarding such a relationship and we seriously feel the need to use such a technology in Iran. To do so and regarding the role of technology and virtual reality tools in interactive architecture, the present study tries to investigate about the basic obstacles of interactive architecture formation emphasizing at utilizing virtual reality technology. Therefore, the research question can be stated as follows:

What are they the basic obstacles in the formation of interactive architecture with an emphasis on benefiting from virtual reality technology?

Research Literature

There have been many researches done regarding interactive architecture during some recent years. Meanwhile, the emphasis on technology in this field and virtual reality has complemented interactive architecture gap in the previous research literature and the present study has been carried out aiming at investigating about the basic obstacles of interactive architecture formation emphasizing at utilizing virtual reality technology. Below, we will refer to some of the closest local and foreign research projects related to the topic mentioned above.

Jelvani Esfahani (2016) carried out research investigating about the characteristics of interactive architecture in order to create a relationship between the user and the environment and architecture space and concluded that interactive architecture utilizes technology and novel digital tools that affect the behavior of humans towards his surrounding environment that increase the belongingness feeling of humans towards the environment. Zafarmandi and et al. (2021) investigated about the application of smart tools in interactive architecture designing in Tehran. Their results represented that the correlation coefficient in interactive space variables and smart materials' characteristics is in an assurance level of 95% and above 0.7 and thus we can identify a variable through describing another variable. The highest correlation score was between temperature and location dimensions amounting to 0.938 and the least amount was between energy and body pressure variables. Lalbakhsh et al. (2022) carried out a study on proposing an architecture design training model based on cooperative and interactive thought in Iran and concluded that architecture designing using cooperative and interactive methods emphasizing at novel technologies has resulted in better efficiency of architecture training among the graduates in the field. This is due to the fact that in such training the distance between academic training and daily lifestyles of the graduates has become shorter and it has led to create much more correlation among those graduates. Bullivant (2005) carried out research on

architecture designing, technology and interactive architecture and found that the truth of interactive architecture lies in the much more integration of levels in current era communications through computer and information technology world and the principles of intellectual perspective of architecture. Therefore, current era architecture deals with integrating architecture and dynamic world and the correlation between them and above them all, the presence of interactive architecture as the major sample of information technology. Rocker and Kai (2012) did a research project on technological aspects of smart houses and the integration of smart information levels regarding an architectural environment and observing the outcomes to investigate about the effect of interactive architecture in smart houses. Results showed that the vast relationship between the different data resulted in interaction between users and the environment and different spaces in houses. However, making them smart has resulted in houses to lose identity in cultural aspect. Xie and Ding (2023) probed on the interactive approach to create space architecture designing based on Graph's theory. Results of producing the designs showed that the proposed method could create a space through which when the relationship between volumes has been adjusted correctly, there would be a rich experience. Domijan and Maric (2024) did research on interactive architecture as approaches to organize the conception and concluded that regarding the convergence in viewpoints of the designers and users in interactive architecture and utilizing smart tools we can achieve perceptual organization in architecture spaces.

Theoretical Foundations

In interactive architecture, the interaction between objects and space is able to change the expanding demands of humans, society, and the environment and a two-way interaction is created with the users and they can adjust themselves with the needs of the other individuals and the environment. Understanding and knowing how to communicate and exchange information between users, materials and tools in architecture and the surrounding environment of the building, can identify the characteristics of administering and activities being carried out in the environment and finally this could lead to discover their interactional relationships and to understand the four principal features of interactive architecture as follows: timing, learning, remembering, and creating (Amini, 2018). In fact, interactive architecture is comprised of assimilation and integration of a set of calculation approaches and methodologies and a physical body. The integration of these two lets the environment to achieve a higher level of changeability and to react the changes automatically, to react against them and to adjust with them and to achieve interaction. Supposedly, interactive architecture can be attributed to buildings and constructed spaces that are able to create an active communication between the users and their surrounding environment (Jaskiewiz, 2013). Also, interactive architecture is known as a type of background architecture that investigates about all three major elements of location sense-meaning, application, and physical environment and creates spaces that entail all three elements

mentioned above (Kandemir, 2016). On the other hand, interactive architecture deals with the efficiency of digital terminals to make decisions regarding the human beings' lifestyles and how do they affect their life. The future is thought to create environments and tools that are not fixed and they can respond to different individual, social, and environmental needs (Fox, 2020). Also, one of the basic features of interactive architecture is that it is cooperative and also cooperation seems crucial. Accordingly, the users, customers, and citizens cooperate within the process of designing. Due to this, their mental images of the spaces are extracted and then they are utilized to create new locations and spaces. On the whole, the basic principles of interactive architecture are as follows (Ekhlasi and Ghamari, 2011):

1. Considering designing aspects;
2. Comprehensive and paten perspective regarding different aspects of designing process;
3. Discovering and understanding the relationship between different elements and their analyses;
4. Creating multiple interactive relationships between all the elements;
5. Flexibility and adjustability;
6. Creating relative equilibrium between all elements;
7. Revising design limitations;
8. Paying attention to development in future.

Fox (2020), states that in nowadays era, the use of virtual reality is considered one of the important tools for the formation of interactive architecture and the realization of its principles. In other words, virtual reality imitates the real working scene and improves the cognitive structure (Li et al., 2017). It also creates some opportunities that can be used as a controllable device and not dangerous to understand the human beings in relation with space and creating locations to implement them through space learning (Sutny et al., 2019). Also, Virtual reality, along with advanced information technology can simulate appropriate spaces in a smart way and enable an individual to carry out activities that are impossible in real world (Bakshi et al., 2020). On the other hand, through integration of virtual reality and artificial intelligence, some new fields are created and this enables space users to experience the phenomena that are impossible in real world. Also, it does not include bodily or financial dangers and this opportunity is proposed to the individuals through which they can experience concepts that were very difficult or impossible to do so in real world (Layer et al., 2012).

In general, it can be said, which in 21st century, the world has almost completely been controlled by technology in all aspects of life (Mondal et al., 2019) and progression and development in technology in architecture has been very prevalent and has led to effectiveness and efficacy (Chen et al., 2020). In this regard, as technology is progressing very fast during the current era and many of human reactions are taken from the object world into the virtual world,

the formation of a virtual world is increasingly developing and the goal of architecture is to form such a world and make it hospitable aiming at increasing interactions (Ekhlasi and Ghamari, 2011). On the other hand, using virtual reality system in architecture has created a new logic following the recent advances in the field which create feeling promotion spaces which are abstract and very tangible at the same time. Therefore, using virtual reality tools in architecture can create a novel dimension of technology and architecture interactions (SajjadiZavieh and Nili, 2013). In other words, virtual reality is deemed something such as living dreams and it leads to the formation of interactive architecture. Accordingly, Mccloy (2014) has emphasized at scientific and practical knowledge and Andriani and Cohen (2013) have stressed on technique, industry, and mental paradigm in realization of interactive architecture in technology and virtual reality. Also, based on the view of Lee et al. (2017), the nature of interactive architecture using virtual reality system is an attempt to create interaction to find solutions. In this process, it is tried to use optimal solutions by collecting and classifying suitable answers. Also, since architecture is a multifaceted and complex process and includes both knowledge and creativity; at first, the architect creatively presents the initial plan by using her mental ability, then by sharing the plan, before building the spaces among the users, by comparing the activities and emotions of the users and analyzing and evaluating the choices of the users, drives the design into a process of creating more human interactions.

Research Method

The research method in the present study is a mixed-methods (quantitative-qualitative) type aiming at functionality and it has an analytic-extractive nature. Accordingly, first the obstacles of the formation of interactive architecture emphasizing at technology of recognition were identified and then a questionnaire was presented to the statistical sample and the most important components of these obstacles were identified. It should be noted that, regarding the location of administering the present research which has been Tabriz, the statistical population of the current research involved architects and university elites and due to the fact that the number of participants were not predetermined, we have used Cohen's formula in an assurance level of 95% to determine the sample.

Cohen's Formula

$N = Z^2 S^2 / d^2$

Where, Z is a fixed amount depending on the assurance distance and error level (α). Considering the identification of assurance distance of 95 percent, d is equal to 0.05 and Z is equal to 1.96. Also, S refers to primary sample variance gained from questioning 20 primary samples. Based on calculations carried out, the variance of the primary sample was calculated to be equal to 0.255. After putting the amounts in formula above the sample was calculated to be

equal to 100 persons and the accessibility to this sample was based on a purposeful non-random sampling method.

N = (3.8416 * 0.0650) / 0.0025 = 100

Also, in this research to measure the internal validity, first the content validity method was used to increase questionnaire validity. To achieve this, the tested indices utilized in the previous research projects were studied and the scholars' views were asked. Then, the organized questionnaire was completed in two preliminary and complementary stages and after studying the responses gained from 30 preliminary questionnaires and carrying out the required statistical calculations, the final questionnaire was devised. To analyze and study the precision amount of questionnaire questions and to measure the appropriateness of analysis tools in the present study, the reliability analysis method of alpha coefficient of all the question items were calculated. Based on the calculations carried out, the alpha coefficients of all questionnaire questions were bigger than 0.7 and the total alpha coefficient was equal to 0.783.

Also to analyze the data we have used the least square model in Warp-pls software and the indexes of Table 1. The questionnaire in this research was based on Likert's 5 item indices.

Table 1. Obstacles of the formation of interactive architecture emphasizing at technology

Elements	Indexes	Sources
Lack of attention to structural goals (A)	Lack of formation of interactive approach between Q1, specialists, lack of attention to material and spiritual needs of humans Q2	(Al-Bayari and Shatnawi, 2022)
Lack of organizing the perspective (B)	Lack of space flexibility Q3, lack of proper relationship between different spaces and unity Q4	(Fritsch, 2011)
Lack of attention to identity maker goals ©	Lack of architecture creativity in different types of geometry, new and novel elements and constituents Q5, lack of variety while being stable that means using contractive symbols, simulation and summarization, form-image and content-conceptual that means an appropriate interaction between spirit and meaning with the body and surface Q6	(Farhad et al., 2021)
Lack of attention to aesthetic goals and abstractness (D)	Lack of use of most abstract material elements and ornaments to pay more attention by the humans to spiritual issues Q7, lack of attention to abstract issues specifically in drawings and using the original geometry Q8	(Fox, 2020)
Lack of completion	Lack of complete respect and caution in dealing with	(Kasmer et al., 2013)

interaction between architecture and nature (E)	nature Q9, lack of complete exploitation of varied weather conditions, reconstruction and recreation of green nature in architecture skethesQ10	
Lack of attention to architecture fields (F)	Lack of using traditional culture and traditional architecture in designing Q11, lack of paying attention to the preferences of the users Q12	(Farhad et al., 2021)
Lack of unity (G)	Lack of understanding and discovering the relationships and creating the relationship between different elements Q13, lack of appropriate relationship between employer, designer, and user Q14	(Passey, 2006)

Source: Documentary studies of the authors, 2024.

Regarding the partial least squares model, it could be stated that the model can be presented in two sections as follows:

Analysis and interpretation of the structural model: A structural equations model that uses partial least squares (PLS) method should be analyzed and interpreted in two stages. First the measurement model will be analyzed and interpreted and then the structural model will be analyzed and interpreted. By investigating measurement model, we mean the probes of weights and loads of the hidden variables and by investigating the structural model we mean analyzing the route coefficients between hidden variables.

Measurement model analysis: In this stage, it could be identified that whether the theoretical concepts were precisely met by variables or not. To do so, their validity and reliability were investigated. In PLS model, individual reliability of each item for constructs, internal consistency, and convergent validity and divergent validity are analyzed.

Finally, after presenting the statistical data and results, we have dealt with investigating the samples of novel buildings' architecture to document the results.

Discussion and Findings

Obstacles of the formation of interactive architecture emphasizing at technology

Validity of the hidden variables

Validity of each of the hidden variables in PLS model is determined through the amount of weights of each variable. The value of each of the element weights of the hidden variables should

be greater than or equal to 0.5. In Table 2, the amount of element weights for indexes of hidden variables of the study could be observed.

Table 2. Weight value of the indexes of hidden variables (Source: authors, 2024)

Hidden variable / Observed variable	A	B	C	D	E	F	G	P-Value
Q_1	0.721	0.237	0.082	0.172	0.077	0.315	0.288	<0.001
Q_2	0.721	-0.273	-0.082	-0.172	-0.077	-0.315	-0.288	<0.001
Q_3	0.235	0.742	0.271	0.147	0.249	0.075	0.146	<0.001
Q_4	-0.235	0.742	-0.271	-0.147	-0.249	-0.075	-0.146	<0.001
Q_5	0.085	0.181	0.735	0.401	0.152	-0.262	0.079	<0.001
Q_6	-0.085	-0.181	0.735	-0.401	-0.152	0.262	-0.079	<0.001
Q_7	0.263	0.244	0.191	0.719	0.273	0.178	0.009	<0.001
Q_8	-0.263	-0.244	-0.191	0.719	-0.273	-0.178	-0.009	<0.001
Q_9	0.156	0.118	0.156	0.244	0.754	0.391	0.247	<0.001
Q_{10}	-0.156	-0.118	-0.156	-0.244	0.754	-0.391	-0.247	<0.001
Q_{11}	0.284	0.257	0.312	0.254	0.227	0.708	0.112	<0.001
Q_{12}	-0.284	-0.257	-0.312	-0.254	-0.227	0.708	-0.112	<0.001
Q_{13}	0.073	0.208	0.152	0.079	0.087	0.411	0.762	<0.001
Q_{14}	-0.073	-0.208	-0.152	-0.079	-0.087	-0.411	0.762	<0.001

As it can be observed in the table above, all amounts of indexes related to the hidden variable in bold are higher than 0.5. Therefore, it can be stated that the measurement model has had enough validity regarding hidden indexes.

Structure validity (internal consistency)

To measure such a validity, the integrative validity index in PLS model is introduced. This index is calculated based on Cronbach alpha coefficient. The amount of this index should be greater than or equal to 0.7. Table 3 represents the validity amount of the structure for each of hidden variables.

Table 3. Validity of structures of hidden variables (Source: authors, 2024)

Hidden variable / Structure validity	A	B	C	D	E	F	G
Integrative validity	0.746	0.751	0.783	0.715	0.745	0.741	0.753
Cronbach alpha	0.728	0.736	0.726	0.739	0.745	0.724	0.714

As it can be observed, all amounts of integrative validity have been calculated to be higher than 0.7. The amount of Cronbach alpha has also been presented in table 3 and it could be seen

that all these coefficients have been higher than 0.7. Therefore, the measurement model has had an appropriate structural validity level.

Convergent Validity

The convergent validity in PLS model has been extracted and analyzed through average variance index (AVE).

Table 4. Convergent validity of structures (hidden variables) (Source: authors, 2024)

Hidden variables Convergent validity	A	B	C	D	E	F	G
	0.732	0.718	0.622	0.691	0.763	0.581	0.719

Regarding Table 4, all average variance amounts extracted have been higher than 0.5 and therefore the measurement model has had an appropriate convergent validity.

Divergent Validity

To measure divergent validity, we investigated whether the extracted average variance amount (AVE) for each structure (hidden variable) has been greater than the second square of the correlation between that structure and other structures in the model or not.

Table 5. Divergent validity of the structures (hidden variables) (Source: authors, 2024)

Structure Structure	A	B	C	D	E	F	G
A	0.763	0.423	0.193	0.369	0.093	0.629	0.541
B	0.521	0.749	0.229	0.175	0.255	0.194	0.376
C	0.318	0.250	0.734	0.067	0.319	0.230	0.216
D	0.372	0.178	0.253	0.772	0.356	0.369	0.169
E	0.416	0.139	0.265	0.569	0.758	0.426	0.261
F	0.267	0.273	0.420	0.641	0.412	0.742	0.231
G	0.312	0.227	0.118	0.239	0.314	0.202	0.736

The amounts of the main diameter in table above show that the second root of AVE and other amounts have had a proper correlation regarding the structures. It could be observed that all structures have had proper consistency regarding the intended conditions. Therefore, it can be said that structures have had proper divergent validity. As it can be observed in table 5, the elements on the main diameter have had higher amounts than others.

Structural Model Analysis

In Figure 1, represents the structural model analysis, the coefficients of each of the routes are represented. Each of the coefficients will be acceptable if the amount of P-value is less than 0.05. Table 6. P-value related to each of the routes

Table 6. Meaningfulness of Route Coefficients (Source: authors, 2024)

Route	Route Coefficient	P-values	Result
A------ TIA	0.521	0.006	Approved
B------ TIA	0.472	0.009	Approved
C------ TIA	0.650	0.012	Approved
D----- TIA	0.403	0.014	Approved
E----- TIA	0.631	0.013	Approved
F------ TIA	0.712	0.042	Approved
G------ TIA	0.584	0.018	Approved
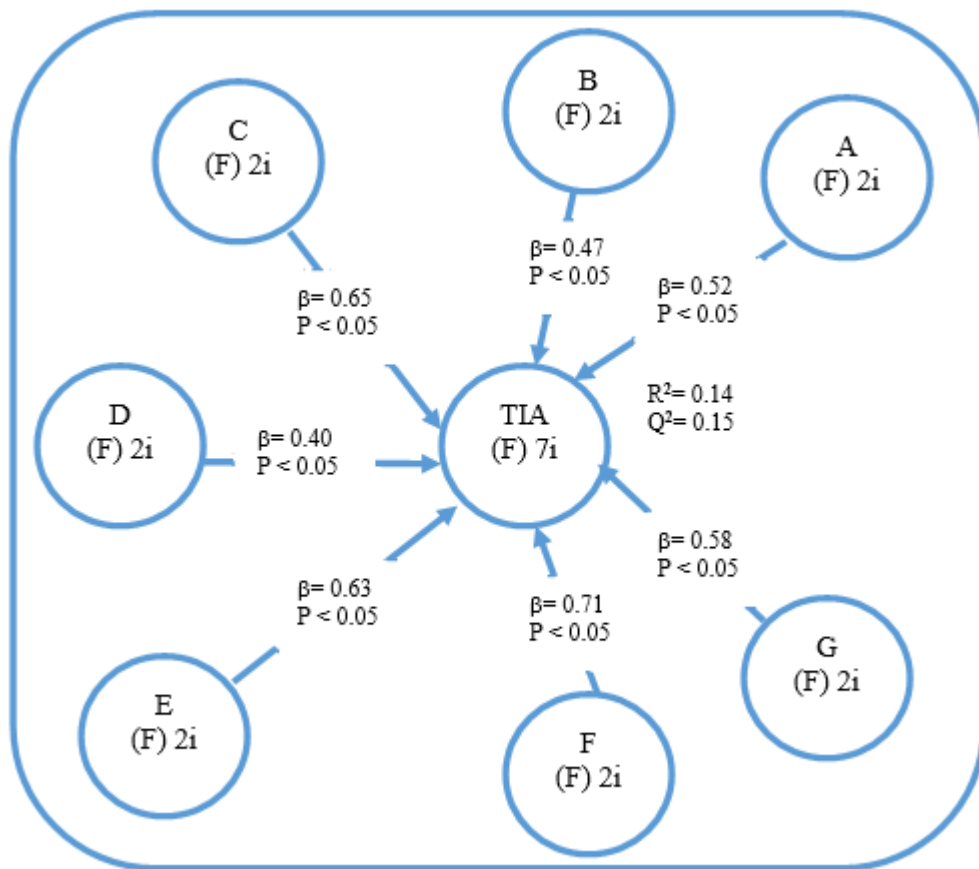
Figure 1. The Structural Model of the Research (Source: authors, 2024)

Table 6 shows the amounts of obstacles of interactive architecture formation emphasizing at technology. As it can be observed all 7 constituents under investigations are from among obstacles of the formation of interactive architecture emphasizing at technology within the study limits that have been approved with an assurance level of 95%. Furthermore, the most important obstacles were: lack of attention to architecture fields, lack of attention to identity maker goals, and lack of complementary interaction between architecture and nature and the coefficients resulted from the structural model of each were equal to 0.71, 0.650, and 0.63, respectively.

Table 7. Coefficients of identifying dependent variables (Source: authors, 2024)

Index Dependent variables	R^2
TIA	0.144

The prediction power of the designed model could be analyzed using the amount of coefficient for the dependent variables. The amounts greater than or equal to 0.1 were identified for the coefficient. Considering Table 8 we can conclude that the structural model of the present research has had enough power. In this model 14.4% of the variable variance of shortcomings of the formation of interactive architecture emphasizing at technology were justified through the input variables.

Table 8. Stone-Geiser Test (Source: authors, 2024)

Index Dependent variables	R^2
TIA	0.151

Based on Stone-Geiser Test, since the amounts of Stone-Geiser Test are calculated to be higher than zero, the model considered has had the required capacity and power for prediction. Stone-Geiser Test coefficient for variables of shortcomings of interactive architecture formation emphasizing at technology was equal to 0.151.

Studying samples in Tabriz considering the utilization of interactive architecture emphasizing at technology

In this part we are going to talk about two contemporary architectural locations regarding the perspective of interactive architecture and their technology. The reason to choose these two architectural areas and buildings is their attractiveness for the audience, novelty, and utilization of famous designers and advanced construction technology in addition to their validity.

Tabriz Blour Tower

Tabriz Blour Tower is one of the very first higher than 20 floor towers that has been designed by Doctor Aliakbar Saremi (one of the most experienced professors of architecture in the country and in middle east) in 2000 and the next year it was started to be constructed. This tower is known as one of the purchase centers and tourist attractions in Tabriz and it is used for business, official works, and services. Also, this structure with 25 floors is considered as one of the highest towers in Tabriz and is comprised of 130 business units, 112 office units, 4 conference halls, a turning restaurant in highest floor and a food court.

Regarding the simulation and virtual reality, the only three-dimensional image of this tower dates back to the time before the construction of this tower and there has not been any relation between the designer and users of this building in designing period.
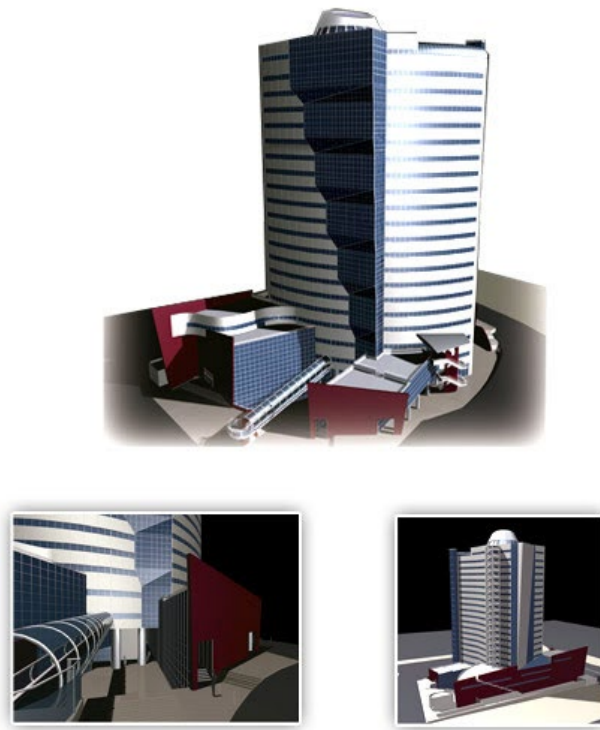
Figure 2. Three-dimensional image of Blour Tower (Source: authors, 2024)

Considering the relationship between humans, this architecture location has a proper status. However, the interaction of human and nature cannot be observed in this architectural space. Also, the construction technology of this location has international standards. This building has an optimal status regarding strength and beauty and citizens have stated in interviews carried out that it inspires a proper environmental understanding to them. Furthermore, this architectural space emphasizes at modern architecture and is far from traditional architecture approaches.
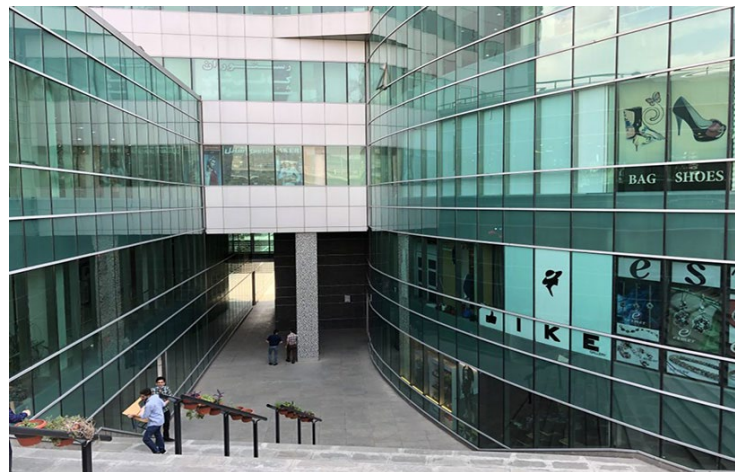
Figure 3. A picture of outer space of Blour Tower (Source: authors, 2024)
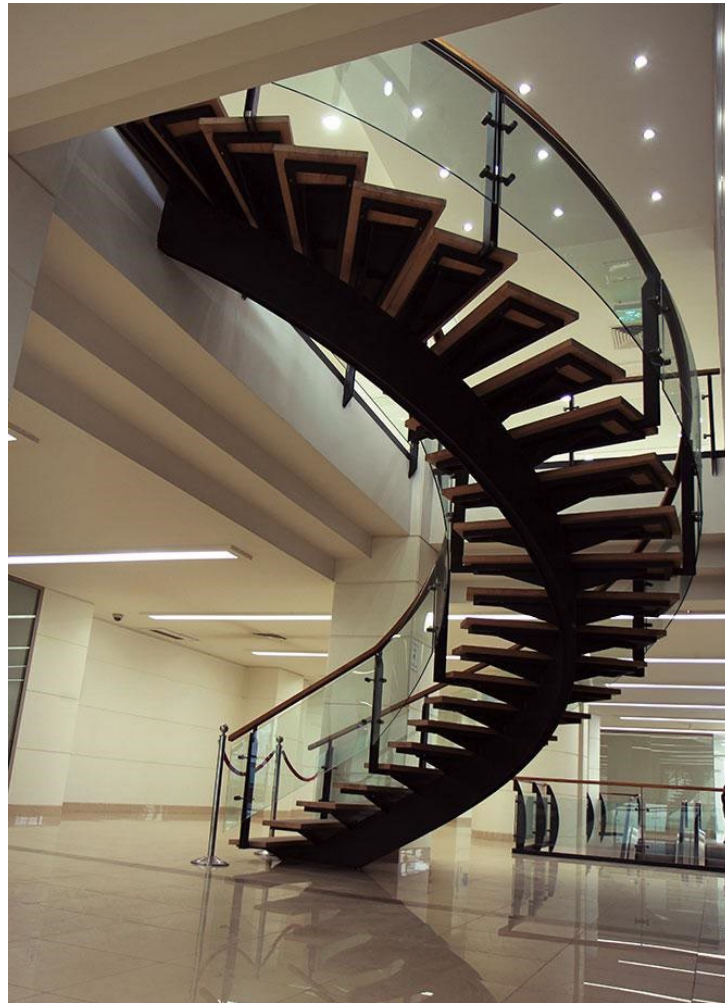
Figure 4. A picture of inner space of Blour Tower (Source: authors, 2024)

Tabriz World Trade Tower

Tabriz World Trade Center and Tower is considered as one of the greatest projects inaugurated in Iran and this gracious project lies within the heart of the ancient Tabriz. It is known as one of the most successful symbols on business constructions in Iran. This project has a hotel, business centers, recreation sections and conference halls. The construction of this structure started in 2007. The major building of this enormous complex includes 37 floors and with a height of 152 meters, it is known as the highest business, service, tourist attraction tower in west of the country.

The features of Tabriz World Trade Center are as follows:

- This center is the highest business, service, tourist tower in Iran with a height of 152 meters.

- It is the very first building through which the special ribbed ceramic panels' covering was administered in Iran.
- The first building with injected rebar connections of NMB type constructed in the country.
- The first high tower equipped with viscous dampers that attract earthquake energy in the country.
- It's the first building in the country built with a concrete having strength of 700 kilograms per square centimeter.
- It's the first building constructed using a hyper-strong rebar with a resistance tension of 7000 kilograms per square centimeter.
- It's easily connected with three western entrances to reach highways and major roads.
- It has a good access to local ways and urban service centers.
- It has more than 1500 covered parking lots and a considerable amount of open-air parking.
- It has used advanced R-PC technology in the structure.

It's the first building administered through the use of prefabricated porches using P-PC technology.

Figure 5. A three-dimensional picture of World Trade Tower (Source: authors, 2024)

Like Tabriz Blour Tower, there has only been a preliminary simulation and three-dimensional images recorded before the construction ending and there could not be any relations observed between the users and the designers of this tower. Also, the relationship between humans is desirable in this space and the relationship between human and natural environment is undesirable. Regarding technology, this building has used the latest achievements in designing this tower and it covers different aspects such as economy and ecology. Meanwhile, cultural backgrounds cannot be seen in this tower.

Figure 6. A three-dimensional sketch of World Trade Tower (Source: authors, 2024)

Figure 7. A picture of the major entrance of World Trade Tower (Source: authors, 2024)

In Figure 8, the latest sketch of World Trade Tower before the construction ending could be observed in this sketch, one cannot see the utilization of nature-based patterns and elements representing cultural backgrounds.

Figure 8. A picture of outer space of World Trade Tower (Source: authors, 2024)

Finally, it could be stated that some of the most important virtual reality terminals to form interactive architecture are the 360 degree rotating terminal, internal reflexive terminal, inspiring terminal or drowning terminal, mixed reality, and added reality system (Fritsch, 2011; Scharff and Val, 2014). The explanation for each of these terminals could be found below:

- *360 degree rotating terminal:* it has a mouse and a monitor or a projector and can represent three dimensional pictures with a possibility of 360 degrees rotation on the screen.
- *Internal reflexive terminal:* it includes a camera, a microphone and sensors that could simulate virtual world to the real world.
- *Inspiring terminal or drowning terminal:* it is inspired through the use of two visual screens equipped with stereophonic mobile phones and inspiring the presence in an environment in a more sensible style to the users through three dimensional pictures and voices.
- *Mixed reality:* an ideal system comprised of an integration of inspiring capabilities and far location recognizer and tracing systems and utilizing three dimensional and six dimensional patterns.
- *Added reality system:* in this system the sketch is so transparent that the user can observe the objects in real environment and in virtual world concurrently.

Studies have shown that 360 degree rotating terminal, internal reflexive terminal, inspiring terminal or drowning terminal have been utilized in designs and architecture in the selected areas

and the other terminals have not been functional. In other words, only the preliminary stages of virtual reality have been used in some of architectural designs trivially.

Conclusion

Virtual reality is in fact an abstract element and the users experience virtual reality through technology regarding the experience of environment understanding and the transfer and movement into another environment. When this technology is being used, the users are inspired in a way that as if they are present in the intended location regarding physics and body and can conceptualize abstract (virtual) objects and communicate with them. By presence feeling we mean a mental picture or awareness, the sense of being in a real environment or a virtual and abstract environment which often is considered as being present in the location. The receipt of highest presence feeling or the creation of such a feeling in the process of designing is seriously in a direct relationship with the development and expansion of designing methods. On the other hand, virtual reality creates the capability of gaining a proper understanding of the effects of three-dimensional locations when we decide in designing. Also, it could be stated that virtual reality technology as a tool for designing and studying the process of virtual designing using the technology deals with improving the relationships and reciprocal understanding between the designers and users. This technology relies on its intrinsic capabilities such as presence feeling to enter most of the fields specifically within architecture and simulation processes and can create tremendous effects in most aspects of human life and such effects are mostly positive and constructive for the future life of human. Meanwhile, studies have shown that in Iran the first stage of virtual reality that means images and three-dimensional sketches, have not been used in some projects and advanced integrated systems and added reality that identify the presence feeling of the users regarding different dimensions. Thus, interactive architecture whose prerequisite is the formation of technology and virtual reality in architecture designs has had a low realization capability. Finally, lack of formation of interactive architecture through virtual reality technology in Iran can be resulted from the following reasons:

- Lack of technical and supportive infrastructures;
- Lack of having the skill to use technology;
- Lack of public access to the technology;
- Resistance against changes and having negative viewpoints towards technology;
- Lack of knowledge and awareness regarding the advantages of using technology;
- Lack of having proper hardware;
- Lack of access to appropriate software.

The most important obstacles of current technologies in formation of the interactive architecture refer to: lack of attention to architecture fields, lack of attention to identity maker goals, and lack of complementary interaction among architecture and nature.

The most important shortcomings of the technology are: lack of attention to architecture fields, lack of attention to identity maker goals, and lack of complementary interaction between architecture and nature.

Based on what was pointed above and the results we can conclude that virtual reality technology is developing and become more complete every day. Thus, utilizing this technology in future in Iran within the field of architecture seems to be necessary. As science and technology is progressing in the present era and human beings are moving towards more uses of virtual world, using the modern era technology seems to be the most challenging thought for human beings in current age. This has been so severe that human beings are moved towards the age of digital humans. The useful application of technology and virtual spaces, in an atmosphere of populated urban areas not only removes the sense of being alone and changes human being into an entity without identity, but also creates a live and dynamic space within the urban architecture space where humans are moving towards much more sympathy and higher urban cultures and the consistency of identity of every nation. Therefore, it could be suggested to do more efforts to create more useful functions of technology regarding different aspects and recognize them and use these tools in architecture and other related fields in order to move towards optimal use of them. On the other hand, the following suggestions seem to be very necessary:

- Promoting technological skills among university students through fundamental changes in teaching trends;
- Emphasizing on appropriate interactions between technology, architecture, environment, and the user;
- Using technology in traditional architecture improvement and reconstruction and mending the monuments;
- Supporting plans and architecture technologies related with culture and urban structures;
- Using different techniques to form interaction and to create relationship between different lines of thought;
- Promoting public awareness in order to use technology;
- Localizing architecture technologies based on the field;
- Emphasizing the identity and meaning in architectural designs.

Author Contributions

All authors contributed equally to the conceptualization of the article and writing of the original and subsequent drafts.

Data Availability Statement

Not applicable

References

Al-Bayari, O., & Shatnawi, N. (2022). Geomatics techniques and building information model for historical buildings conservation and restoration. *The Egyptian Journal of Remote Sensing and Space Sciences, 25*, 563–568. https://doi.org/10.1016/j.ejrs.2022.04.002

Amini, M. (2018). *Interactive architecture semi-sketches; the process of interaction in novel technologies and current era architecture in Iran.* PhD dissertation in architecture, Tarbiat-Modarres University (Teacher Training University), The Department of Arts and Architecture.

Andriani, P., & Cohen, J. (2013). From exaptation to radical niche construction in biological and technological complex system. *Journal of Complexity, 18*(5), 7-14. https://doi.org/10.1002/cplx.21450

Bakshi, S. K., Lin, S. R., Ting, D. S. W., & Chiang, J. (2020). The era of artificial intelligence and virtual reality: transforming surgical education in ophthalmology. *British Journal of ophthalmology, 105*(10), 1325-1328. https://doi.org/10.1136/bjophthalmol-2020-316845

Boychenko, K. (2019). Re-defining the Role of Interactive Architecture in Social Relationships. *International Conference on the 4th Game Set and Match (GSM4Q-2019)*, Doha, Qatar, 6-7 February 2019.

Bullivant, L. (2005). Ada: The Intelligent Room. *Interactive Architecture, 75*(1), 86-90. https://doi.org/10.1002/ad.20

Chen, L., Chen, P., & Lin, Z. (2020). Artificial intelligence in education: A review. *IEEE Access, 8*, 75264-75278. https://doi.org/10.46793/TIE22.223K

Domijan, D., & Maric, M. (2024). An interactive cortical architecture for perceptual organization by accentuation. *Neural Networks, 169*, 205-225. https://doi.org/10.1016/j.neunet.2023.10.028

Ekhlasi, A., & Ghamari, H. (2011). The effects of architecture of virtual spaces on humane environments, architecture, and urban constructions in Iran. *Journal of Architecture and Urban Construction in Iran, 1*(2), 5-10. https://doi.org/10.30475/isau.2011.61933

Farhad, S., Maghsoodi Tilaki, M. J., & Hedayati Marzbali, M. (2021). Architectural identity and place attachment in historic neighbourhoods: an empirical study in Sanandaj, Iran. *Journal of Place Management and Development, 14*(2), 148–162. https://doi.org/10.1108/JPMD-02-2020-0018

Fox, M. (2020). *Interactive architecture: adaptable world* (Hamzelou, S., and Esfandiarifard, E., Trans.). Tehran, Ketabkadeh Kasra Publications.

Fritsch, S. (2011). Technology and global affairs. *Journal of International Studies Perspectives, 12*(1), 27-45. https://www.jstor.org/stable/44218647

Jaskiewicz, I. R. T. (2013). *Towards a Methodology for Complex Adaptive Interactive Architecture*. Ph.D Dissertation, Technical University Delft, Poland.

Kandemir, O. (2016). Effects of Contemporary Information Technologies on Culture and Architectural Space. *Proceedia Engineering, 161*(4), 1458-1461. https://doi.org/10.1016/j.proeng.2016.08.610

Kaşmer, Ö., Ulusay, R., & Geniş, M. (2013). Assessments on the stability of natural slopes prone to toe erosion, and manmade historical semi-underground openings carved in soft tuffs at Zelve Open-Air Museum (Cappadocia, Turkey). *Engineering Geology, 158*, 135-158. https://doi.org/10.1016/j.enggeo.2013.03.010

Knox, K. (2017). Interactive Architecture: development and implementation into the built environment. *European Journal of Technology and Design, 10*(31), 20-25. https://doi.org/10.13187/ejtd.2017.1.20

Lalbakhsh, E., Ghobadian, V., & Azizi, S. (2019). Architecture designing teaching model based on cooperative and interactive thought in Iran. *Journal of Teaching Technology (Technology and Teaching), 13*(4), 819-829. https://doi.org/10.22061/jte.2018.3519.1886

Layer, R., Sheriff, M., & Tychonievich, L. (2012). In Form, Experience, Implement- Teaching an intensive high school summer course. *Paper presented at the 2012 Frontiers in Education conference proceedings*.

Li, M., Li, L., Jiao, R., & Xiao, H. (2017). Virtual reality and artificial intelligence support Future training development. *Paper presented at the 2017 Chinese Automation congress (CAC)*.

Liang, Y., Meng, F., Zhang, J., Chen, Y., Xu, J., & Zhou, J. (2021). A dependency syntactic knowledge augmented interactive architecture for end-to-end aspect-based sentiment analysis. *Neurocomputing, 454*, 291-302. https://doi.org/10.1016/j.neucom.2021.05.028

Mccloy, D. (2014). *Technology: Made simple*. London: Heinemann.

Mondal, A., Mukherjee, A., & Garain, U. (2019). *Intelligent tutoring by diagram recognition C3-Advances in intelligent Systems and Computing*. In (Vol. 727, pp. 141- 149): spring Verlag.

Passey, D. (2006). Technology enhancing learning: Analyzing use of information and communication technology by primary and secondary, school pupils with learners frameworks. *The Curriculum Journal, 16*(2), 139- 166. https://doi.org/10.1080/09585170600792761

Röcker, C., & Kai, K. (2012). *Interactive architecture in domestic spaces*. Constructing Ambient Intelligence, Springer Berlin Heidelberg.

Sajjadi-e-Zavieh, S. A., & Nili, R. (2022). Evaluating the system of connecting human beings with nature in virtual reality system aiming at presenting and reflecting a model within the body of architecture. *Journal of Architecture and Urban Construction in Iran, 13*(1), 181-199. https://doi.org/10.30475/isau.2022.230954.1415

Scharff, R. C., & Val, D. (2014). *Philosophy of Technology: the technological condition: An Anthology*. United State: Blackwell Publishing.

Stanica, L., Dascalu, M. M. L., Bodea, C. N., & Moldeveanu, A. D. B. (2018). VRjob interview simulator: Where virtual reality meets artificial intelligence for education. *Paper presented at the 2018 zooming innovation in consumer technologies conference (zlwc)*.

Sutny, P., Babiuch, M., & Foltynek, P. (2019). A review of the Virtual reality applications in education and training. *Paper presented at the 2019 20th International Carpathian control conference (ICCC)*.

Telma, T., & Pacheco, P. (2009). Architecture as cognitive and interactive factor on virtual museums. *Cognitive processing, 10*, 319-321. https://link.springer.com/article/10.1007/s10339-009-0308-5.

Xie, X., & Ding, W. (2023). An interactive approach for generating spatial architecture layout based on graph theory. *Frontiers of Architectural Research, 12*(4), 630-650. https://doi.org/10.1016/j.foar.2023.04.003

Zafarmandi, S., Amirjamshidi, M., & Sanaee, A. (2021). The use of smart tools in interactive architecture designs (A case study: Smart urban buildings in Tehran). *Journal of Novel Research in Geographical, Architecture, and Urban Construction Sciences, 4*(32), 151-166. https://pantajournals.ir/article.aspx?aid=12351

Comparison of the Contextual Components in Regeneration of Industrial Cavities in Tehran City

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Article Info	ABSTRACT
	In today's era, urban development is at the cost of destruction of architectural heritage, industrial architecture, gardens, and their history. Paying attention to the context for reviving industrial tissues and cavities can be an important approach to create tissue recovery. However, contextualism can be effective in improvement, renovation, or reconstruction processes. This research seeks to know the components of contextualism that are effective in improving the dysfunctional tissues of Tehran city. This research is qualitative and quantitative method. Qualitatively, semi-structured interviews were used to extract contextual components and distributed among 28 experts using ATLASTI8 software. Quantitatively, to check effectiveness of each element in improving the texture (renovation, reconstruction), Likert scale questionnaire was given to 384 engineers and architectural designers in Tehran engineering organization. Questionnaire results were analyzed with JMPSAS17. Results showed that highest factor load in the spatial contextualism components related to good feeling of security as (1.000) and the lowest related to beauty component of the adjacent axis as (0.343). The environmental contextualism, the highest coefficient of determination is the positive influence of the surrounding environment as (0.695) and the lowest is the collective protection with prohibitions value (0.356). Socio-cultural contextualism, cultural attractiveness as (0.951), the highest factor is cultural diversity as (0.306). Physical contextualism, the highest factor contribution is related to physical beauty and physical lighting as (1.000) and the lowest to appropriate positioning as (0.511).

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[1]The present article is derived from the firt author's doctoral dissertation entitled "The Statement of Proper Architecture Intervention in Cavities of Urban Fabric of Metropolis Historical Zone (Comparison between the Hitorical Context of Tehran and Berlin)", which is being developed under the supervision of second author and the advisor of the third author at the Faculty of Architecture and Urban Planning of Islamic Azad University, Central Tehran Branch.

Introduction

The urbanization of the 20th century was formed under the influence of the changes and transformations of the modernism flow and the developments resulting from the transformations of the industrial revolution based on wisdom and technological power (Pour Ahmad and Vafaei, 2016). Relying too much on the power of technology and technology, the concentration of comfort and welfare facilities in cities, the unprecedented influx of population into cities, the transformation of land into capital and a source of profitability, leading to the emergence of the principles of mechanical urban development, bulldozing, The emergence of areas lacking the principles of architecture and urban planning and the abandonment of some physical-spatial elements in the overall structure of cities over time (Sajjad Zadeh and Zolfi Gol, 2014) and the result of the above-mentioned changes is the appearance of an ugly and unconventional face of cities, which is a necessity and The importance of intervention and dealing with these physical elements was felt more and more by city managers and thinkers in the fields of restoration, architecture and urban planning. Interventions and encounters in the abandoned elements and textures, which in this article are referred to as urban holes in the historical context, in every country and even in every city according to the prevailing economic-social, political, historical and cultural contexts. on that society has been different.

Big cities with a historical and industrial record in Iran are being destroyed under the blade of development. Failure to make the right decisions and lack of will to prevent wear and tear, greed and speculation have turned the gardens into ruins ready to cut trees and architectural heritage which turns it into a warehouse of materials, and finally, with destruction (the most basic method of intervention), after producing a mountain of construction waste, in addition to environmental pollution, it leads to the production of construction products, which in the best case, maybe even valuable in its time, he should spend as much time as its dead predecessor to settle down. These interventions are not in the valuable historical cores of the city, but have spread to individual buildings, gardens, etc. The totality of these interventions with the spaces of abandoned buildings has given the city a network of ugliness, identity lessness, and disorder (Almodaresi, 2020: 69).

The city has its identity from its passages, buildings, and memories. The destruction of these images, the destruction of these memories, depletes the city of its identity and value, even if the excuse is imposition and the need to increase functions and the need for more and newer spaces.

This research seeks to identify the context-oriented aspects and examine the extent of their factor contribution in creating improvement, renovation or reconstruction and tries to answer the question of which of the contextual components plays a more significant role in the interventional aspects of improvement.

Theoretical Foundations

Regeneration Interventions

Regeneration is considered the main approach to urban restoration and protection in the contemporary era. The word "recreation" means "to create something again". The word "Regeneration" comes from the verb "Regenerate" which means to revive, to revive, to revive, to grow again (Venturi and Scott Brown, 2000). In urban studies, it is a term that refers to urban changes through redesign, reconstruction, and often the reallocation of urban land (Kim, 2015: 337-338). In the beginning, urban regeneration was the concept of using reclaimed land in changing the use of urban land, due to the change in the approach of industrial production in cities and ports after the 1970s.
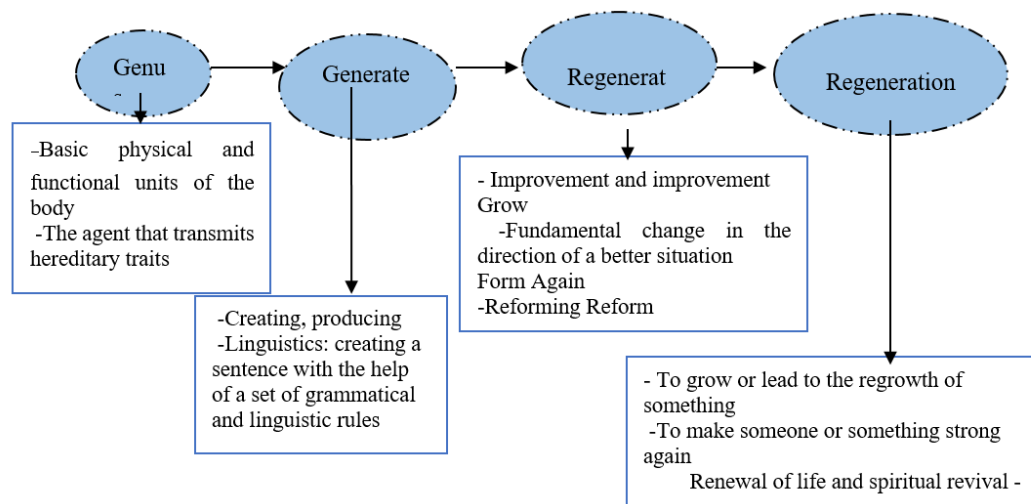
Figure 1. Urban regeneration and its related features (Source: Deek, 2017).

This term is widely used after 1995 as an alternative to urban renewal in the field of urban planning literature. found Urban regeneration has been proposed since the late 1980s and early 1990s in advanced countries, such as the Netherlands and the United States, and has been used to improve dilapidated neighborhoods and improve the quality of living in them. This approach was adopted following the failure of the implementation of purely physical-spatial programs, because the governments realized that investment in urban renewal without the simultaneous process of social-economic renewal can be completely neutralized (Habibi and Maqsoudi, 2012: 5).

Industrial lands have the greatest potential for regeneration to become a new place that includes visual and cultural values in addition to structural attractions, along with observing ecological issues. The goals of regenerating brown lands include creating new opportunities, economic growth, strengthening society, improving environmental conditions, cultural

prosperity, and promoting new values at the level of local communities, etc. (Almodaresi, 2020: 69).
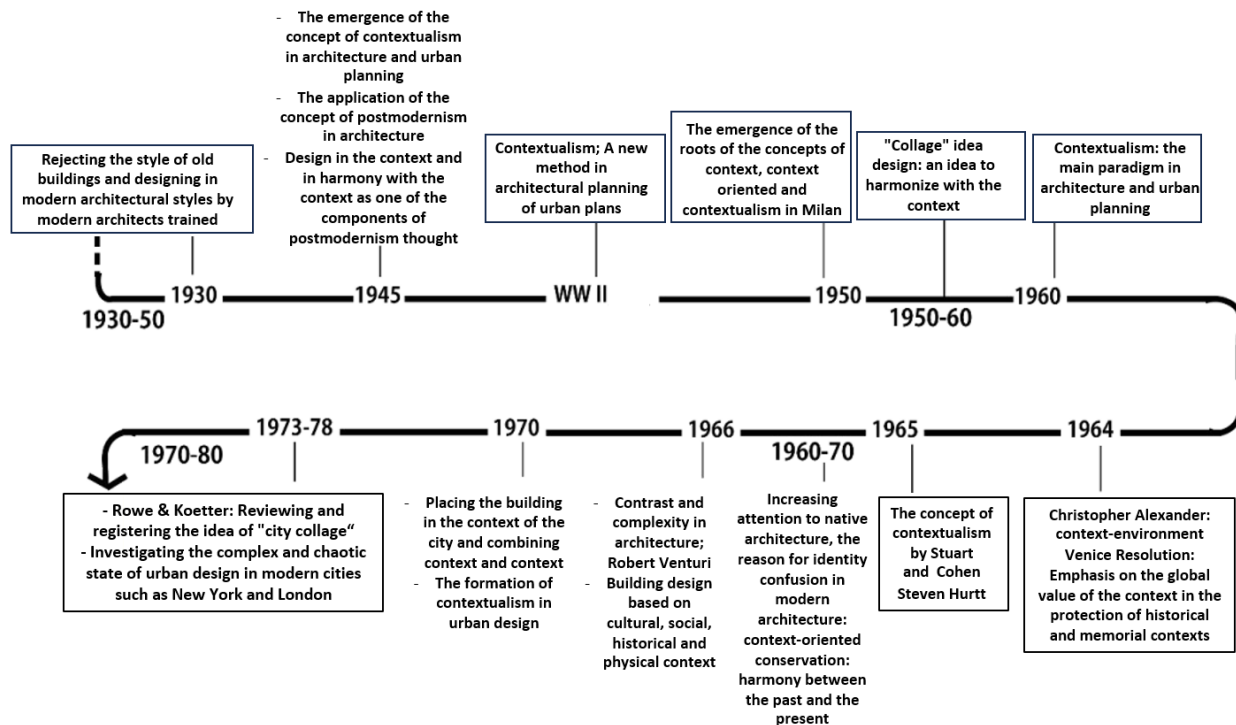
Contextualism

Regionalism is an analytical and critical point of view that emphasizes the preservation of specific features and characteristics of a place, and in this sense, it is opposed to globalization and international style, and it seeks the continuity of local traditions. The formation of the regional approach provided the necessary background for the emergence of contextual thinking in urban planning and architecture (Ludlow, 2005: 11). The term contextualism was first published by Stuart Cohen & Steven Hurrt in an unpublished treatise entitled " Le Corbusier: The Architecture of City Planning". These discussions started in the late 1950s and were continued in 1955 by Colin Rowe & Bob Slutsky with the article "Transversal and Real Transparency" (Almodaresi, 2020: 69). Until the first statement This thought was presented by the idea of Collage City by Colin Rowe. In 1973, Colin Rowe and Fred Kotter began to study and record the idea of collage city and published it in 1978, and thus, the concept of contextualism was formed (Taban, 2020).

(Ludlow, 2005: 11) Contextualism is a new way to respond to constructions. The new is in agreement with the context around it, instead of destroying it. Contextualism has specific coordinates in the process of intertextual development (Dorsey, 2003) because of the nature and essence of the concept of endogenous development, which is the brain and essence of intertextual development (Figure 2).

According to Payne (2016), contextualism has three different uses in philosophical perspectives. First, the conditions for the truth of a group of claims are different according to the context of speech (Pynn, 2016). Second, contextualism is a label used by philosophers of language to propose the issue that linguistic meaning is strongly dependent on the context. They believe that it is only in the context of speech that a word defines a concept (Recanati, 2012: 171). The third application of contextualism in philosophy is used by epistemologists on theories that have no connection with semantics, and Williams considers it a perspective. that justification occurs in an informational and dialectical context. Contextualists put forward the premise that the epistemic standard in a given context influences people's intuitions about the truth or falsity of the knowledge documents expressed in that context (Bach, 2005: 63), thus realizing the central role of the knowledge assigning context. In the doctrine of contextualism, on this basis, the goals, expectations, and presuppositions of the assignor are considered the context of the assignor (Falamaki, 2004).

Contextualism is contrasted with sensitive fixedism. According to contextualists, the context of documenting interests, goals, expectations, desires, presuppositions and intentions of documenting knowledge is the possibility of an error that is explicitly mentioned in the context of

the documenting speech (Almodaresi, 2020: 70) (Table 1). On the other hand, in sensitive constancy, the semantic content of epistemic documents is determined independently of the context of the document provider and the practical position of the subject of knowledge, and the semantic content and truth value of these documents do not change with the change of the context of the document provider or the practical position of the subject of knowledge (Kim, 2015: 337-338).

Figure 2. The course of historical evolution of the concept of contextualism in the modern and postmodern period (Source: Naghavi, 2018; Moayedfar et al., 2017).

Table 1. Opinions of experts regarding contextualism and its dimensions (Source: Naghavi, 2018; Hemmati et al., 2024; Moayedfar et al., 2017).

Theorists		Descriptive principles and basics
Different dimensions of the field	Robert Venturi	The design of each building is in accordance with its cultural, historical, physical and special conditions.
	Alan Waterhouse	Context in architecture is like a historical event in which the elements of the city are known, treated and built. Contextualism in architecture is interpreted as having a context and foundation or respecting and adapting to the context, which refers to its various dimensions.
	Merrill C. Gaines	The classification of context in architecture is done under three general topics of sub-patterns, activity patterns and climatic patterns.
	Novin Tavallaei	The presence of ideas and elements of past cities in shaping the body of contemporary cities. Contextualism is adaptation to the physical, historical, social and cultural contexts that are present in shaping the body of contemporary cities according to the ideas and forms of the past.

Emphasis on the historical dimension of the context	Paul-Alan Johnson	The relationship between architectural theory and history is like the relationship between form and context. The form cannot be seen without the context, and the context has no meaning without the form.
	Charles Jencks	Emphasizing the direct transmission of meanings to people through active communication codes and favoring traditionalism aware of the developments in today's world.
	Patric Geddes	The theory of "conservative surgery" and emphasis on efforts to preserve architectural and cultural traditions considers it necessary to study and pay attention to cultural identity and pay attention to the economic, geographic, geological, historical, etc. background before any design.
	Aldo Rossi	Looking at the structure of the city as a whole and according to the relationship of its different parts. He combines creativity and memory and brings cultural memory to Wood with a limited reading of the city.
Emphasis on the physical dimension of the context	Christian Norberg-Schulz	The meaning of each object is rooted in its relationships with other objects. While the structure refers to the shape and form characteristics of a group of relationships.
	Pierre von Meiss	Readability of form from the context is the first step in architectural analysis. The beginning of the analysis and perception of space comes from the legibility of the form in the context and its interpretation is based on the physical relations of the form. The relation of shape in the context is not only in perception, but it is a fundamental thing in the formulation of architecture.
	Rowe & Koetter	Looking at the city as a set of areas where each area is a vast area whose spatial-form characteristics are defined by the organization of masses and spaces in coherent and precise patterns that can be identified in form and context. Emphasis on creating a relationship with the physical context and paying attention to the hierarchical system of collections and evaluating the components of the city structure in a wider context.
	Edmund Bacon	Paying attention to context orientation and the impact of architectural work on the context and formation of urban space as the principle that has been observed in Renaissance architecture.
	Lewis Mumford	Regionalism is a return to the past that can be used for the present, a tendency towards regional and native styles.
	Rob Krier	Paying attention to issues such as morphological aspects of context, classification of urban spaces, emphasis on building legible public spaces, continuous yet diverse urban space system, historical continuity, socio-cultural performance and social communication, etc.
	Camillo Sitte	Emphasis on preserving the surrounding environment of each building Continuity of urbanization through recognition of its rules
	Roger Trancik	Coordination of new pieces with existing spaces and architectural forms through gradual filling Every visual sign can be separated from the text or context and create a new context and text. Every urban environment has a specific pattern for mass and space, but urban design is successful if it can create a positive symbiosis between mass and space.
	Cohen & Schumacher	The theory of form adaptation from context It refers to creating a relationship with the context and adapting the form from the context in all kinds of contexts, including natural, historical, cultural and physical.
	Anthony Togganet	It allows innovation in the context under conditions such as the compatibility of the scale of the element with the context, continuity in order to create a relationship between the buildings, the height of the floors and the height hierarchy of the buildings, etc.

Emphasis on the natural dimension of the context	Christian Norberg-Schulz	Since contextualism is the adaptation of form from the context, it includes various contexts, including the natural context. The regional characteristic is not only hidden in the local architectural forms, but also includes a broader concept of environmental identity and includes the natural forms of the land and plants specific to that area.
	Frank Loyd Wright	He is the founder of organic architecture, which emphasizes the connection and harmony between architecture and nature and the designer's compatibility with his environment.
Emphasis on the socio-cultural dimension of the context	Kenneth Frampton	As a theoretician of "Critical Regionalism", he believes that architects in their buildings should seek regional variations rather than global design in a uniform manner. Architects must combine the influence of global civilization and the themes arising from the characteristics of a particular place. His regionalism emphasizes the relationship of the building with the site and its place in a sociological context.
	Amos Rappaport	Culture in the sense of a set of values, beliefs, world view and common symbolic systems helps people to give meaning to their environment and transform spaces into places.
	Bill Hillier and Julienne Hanson	Proving the importance of the community meaning of the city form In the city, the most important thing that creates meaning is not the sign; Rather, it is the whole saying or expression.
	Christian Norberg-Schulz	When the space finds cultural content, it becomes a place. The characteristic of the place includes both the objects that have shape, texture and color and also the cultural relations that are created due to the passage of time.
	Ross King	In linguistics, architecture is the language of which the city is the "text" and in "semantics" the form of the city is the text to be interpreted.
	Christopher Alexander	The context is a part of the design that is induced into the form, so it is suggested to harmonize the form with the context.

Contextualism has different types that can be mentioned as follows;

Spatial contextualism

There are few definitions of contextualism in the production of space. Robert and Stern consider contextualism as the possibility of developing a building in the future and the desire to create a relationship between the building and the surrounding environment (Brolin, 2012: 15). Mahdavi nejad et al. and the connection between environment and space in space design is considered contextual architecture. According to the researcher, the first definition is strictly physical and does not consider cultural and social aspects (Falamaki, 2004). Therefore, contextualism in the production of space can be seen as a functional and apparent semantic connection between space and context. This means that based on the idea of contextualism in the construction, design, planning and even the understanding of urban spaces and places, there is a need for functional and formal semantic communication between the mass and the surrounding context (Deek, 2017).

Physical contextualism

In the context, the components of the city form are not evaluated and studied alone, but they are placed in a wider environmental context. A great architectural work is related to a large urban

system and is placed in a hierarchy of collections. The tendency of city planners to build in a collection existing means interweaving new and old in a way that can create a living and desirable whole contextual architecture, while not emphasizing imitation, does not hinder innovation and creativity, and its message is the need to pay attention to the physical environment. It is about the architectural work, which is a positive and strengthening aspect for both the architectural work itself and the context (Brolin, 2012). Although contextualism contradicts the essence of modernism (Hemmati et al., 2024: 69).

Because the modernists considered the production of space as a logical and inevitable result of economic-functional necessities. From the point of view of a modernist, the building must be prominent and prominent compared to the surrounding buildings and be a symbol of the future (Brolin, 2012: 10).

According to Robert, Stern, postmodernists have common principles in the following areas: (1) contextualism, the possibility of developing a building in the future and the desire to create a relationship between the building and the surrounding environment (2) allusion and irony to the history of architecture in a way that has passed the limit of selection; (3) Tendency to arrays, a simple pleasure from building arrays (Moayedfar et al., 2017: 16).

With all these attributes, Lynch believes that if the signs have a clear form, if they are in contrast with their context and dominate their place, they will be recognized easily and have a meaning that can be carried in the mind. He also adds that the most effective factor in creating a sign is an image or a form that is distinct from its context (Falamaki, 2004). Although Kevin Lynch's opinion is more based on the modernist approach to urban planning and he did not benefit from the principles of postmodernism in presenting his view, so his opinion cannot be considered a theory based on contextualism (Almodaresi, 2020: 69). Regarding physical contextualism, there are two important theories that are mentioned here. Although these two theories are slightly similar, the outcome of these two theories is physical and visual sequence (Rezaei Rahimi et al., 2020: 38).

Socio-cultural contextualism

Socio-cultural contextualists believe that culture creates a set of rules that is a reflection of its construction. With the help of culture, that is, a set of values, beliefs, worldviews and common symbolic systems, people give meaning to their environment and transform empty space (Rappaport, 1990: 6). Urban space is considered to be a stable element in the level of civil life, privileges and capitals of the city. Urban space in the level of civil life is the place of the emergence of culture and the continuity of life in the city with the level of civil life and the approach of citizens becomes aligned (Habibi and Maqsoodi, 2010: 257). Based on this, Roger Transic's definition of place theory can be a good theoretical foundation for socio-cultural

contextualism. The theory of place is the basis of the theory, the place to understand the human and cultural characteristics of the physical space (Falamaki, 2004). From a physical point of view, space is a limited and purposeful empty ground that potentially connects objects. But this space is called "place" when it finds the meaning of land. The characteristic of place includes both objects that have material, shape, texture and color, as well as cultural relationships that are created by human use over time. It is also in the place that the vitality of social interaction appears and memories have their origin in places (Rezaei Rahimi et al., 2020: 42).

People need relatively stable systems of places where they can develop their culture, social life and personality. The task of city planners is to create a balance between the physical identity and the sense of place, as well as to create a place that best fits the physical cultural context, the needs and expectations of the users (Falamaki, 2004). In order to create these places, city planners need to examine the historical context, to know the needs of the society in order to respond to them, to be aware of the past traditions in the construction of these places, and to be flexible to change in the present and the future. Usually, the most successful design of places originates from the least intervention in the social and physical environment (Tefagh and Yarmand, 2019: 37).

Urban designers significantly compared to the importance of historical, cultural and social values and the theory of place, give an obvious construction to the solid and empty body and respond to human needs and unique elements, and people demand a sustainable system of places by which, to their social life and culture should answer. Roger Tran Sik's theory of place, which is one of those urban design theories. The necessity of place theory in spatial design is to understand the cultural and human characteristics of physical space and spaces are based on category and typology that each place appears unique and unique (Hemmati et al., 2024: 73).

In general, the theory of place is based on the understanding of the human and cultural characteristics of the physical space in order to transform it into a place. From the transistic point of view, if we consider the space as a bounded or purposeful space with the potential to communicate between objects, it becomes a place only when it has a meaning. It is based on the demand of cultural or regional content (Falamaki, 2004). Also, paying attention to the cultural principles of a place in creating space can create communities with identity and originality. In contrast to this thinking, we witness that in the most recent urban development, new cities and neighborhoods fail to create a spatial concept of responding to the physical environment. Remaining symbols and fragments of the past are disappearing. The continuity of time is lost. Even in the construction of the 1960s, the barriers of the site were neglected (Moayedfar et al., 2017).

According to this theory, the new built space must be a reflection of social relations, culture, lifestyle, ruling ideology, and values in order to have contextual characteristics from a social point of view. According to Christian Norberg Schulz in his book titled "Spirit of place towards

the phenomenology of architecture, the spirit of place creates a distinctive character and identity for a place and it is a combination of the function of art and architecture that people's activities in the public space often create the spirit of the place. (Zhang and Zhou, 2009).

The success of a project is the product of understanding people and geographical features of the place. In the construction of places, buildings and open spaces, it is necessary to know the dynamics and characteristics of a society. In this context, opinions of local people, local history and customs, Opinions of influential people, organizational and institutional characteristics, and policies should be considered (Saif al-Dini, 2013: 164).

Historical contextualism

From Rappaport's point of view, history is not only the narrator of events, but historical data can be used to answer questions in a specific scientific field (Rappaport, 1990:80), the crying historians are of the opinion that history should have lessons for current urban planning. The current society cannot separate itself from the past emphasize on respecting the past of traditionalism, preserving old textures. Thinkers emphasize on the protection of pre-industrial cities due to their historical characteristics and innovative perspectives. And proposed the term "cultural heritage" and praises the protection of heritage on an urban scale without diminishing the importance of urban development, because according to Giovannoni, the historical city is both a historical monument and a fabric of life (Veldpaus and Roders, 2013: 8).

Environmental context

Throughout history, humans always try to harmonize their residential environment with the climate of their surroundings; (Falamaki, 2004) but contemporary architecture does not have the ability to harmonize with the surrounding climate and this disharmony has created many environmental problems. If you are aware of the possibilities of your environment, you can prevent their destruction. And how to place the building in the place and maintain the surrounding environment and the access of vehicles and pedestrians, for this purpose it seems necessary to know the climate (Mahdavinejad et al., 2010: 28). Nature can also be a source of inspiration for designers and architects to get shapes, textures, and colors. If this connection is taken into consideration in biophilic architecture and according to the climatic and micro-climatic aspects of human comfort, energy efficiency, and green space, the building is designed (Almusaed, 2011).

On the scale of the city and beyond the architecture, the biophilic city is a city that, by learning lessons from nature and taking natural forms and images from the natural systems, uses them in the buildings, urban visions, and plans and programs related to nature (Beatley, 2011:4).

On the basis of planning based on environmental contextualism, we can create conditions that ensure both the comfort of human life and work and the planning done does not conflict with the environment. Accordingly, environmental contextualism is based on sustainable environmental development.

Contextual approaches in architecture

Three types of orders can be considered for the field of architecture and space production. In the first factor, the context is the cultural and social environment in which a person lives. In the second factor, architecture is separated from the time of its creation like an event, time passes on it, different meanings appear on it and it is added to the meaning of the work (Falamaki, 2004). By default, information is a text field and must be read. The third order is from the context of our definitions of issues related to the work and its past. This order of context is infinite and increasing in nature; Because every day new interpretations about the past and other issues arise (Soltani, 2012: 12).

Regarding how to look at the context in design, there are three approaches in general: the effect-oriented approach, in which the effect is not the result of the context, but it is considered the result of the creator of the work (architect). In the second approach, the contextualist creates the work and is a product of the context (they know the conditions and even the architect himself is a product of the context) (Deek, 2017). Contextualists believe that in the work of understanding the work of art, we should pay attention to issues other than the work of art itself in order to fully understand it, for example, if we find other works by the artist, we should pay attention to them, or if there are other works in the same style. Let's talk about them too (Tefagh and Yarmand, 2019: 37).

In the holistic approach, it is necessary to refer to the context and the effect, and the effect and the context are considered as a single unit, and they separate the two for a better understanding of the truth (Soltani, 2012: 13). Michelle Davis believes that design in historical environment can be done with more than one approach. He divides the approaches between the two extreme levels mentioned above into five categories and defines them as follows: (Shefa'i, 2016: 12).

Imitative approach: design achieves harmony with its surrounding environment by imitating external factors and existing order;

Traditional approach: Like the imitative approach, it is an approach that is highly debated about its preference.

Arrogant approach: This approach is very self-confident and pays almost no attention to the historical context; (Falamaki, 2004).

Contemporary approach: the design in this approach is contemporary with language and receives hints from the present; It also takes inspiration from the past and respectfully talks with the historical context; Sensitive approach This approach has a more balanced and humble behavior towards the environment. This approach has the greatest respect for the historical context in its works (Hemmati et al., 2024: 79).

Several approaches can be taken regarding the relationship between the building and the context

1. The context is unrelated, a person who builds his building on a sandy beach. This approach lacks foresight;
2. Context has functional importance. It examines the internal effects of contextual factors on construction. Considerations related to this approach include stability, land, moisture, precipitation, heat, security and other factors;
3. The context has environmental importance; it examines the external effects of construction on the context. This effect can include air, water, soil, animals and humans;
4. The context has aesthetic importance. This approach monitors both the internal and external effects of construction on the context. The range of considerations of this approach includes mass color, line, pattern, and facade materials (Turner and Millimian, 1996: 16).

Intervention in urban contexts

In the Persian language, the term "intervention in urban contexts" is used as a general and general term that can include all detailed specialized actions and methods in this field. Such a situation is not seen in the specialized literature of industrialized countries. It means that certain terms are used for different conditions (Tefagh and Yarmand, 2019: 40).

In the term of urban development, various solutions and interventions are proposed in order to improve urban centers or, more precisely, inefficient urban contexts. The policies and intervention programs in urban inefficiency contexts in each period are in accordance with the dominant approaches, effective and guiding forces (economic, political and social) (Falamaki, 2004) as well as the environmental, economic and social conditions and characteristics of the cities, which have characteristics and dimensions that are representative of the period and based on the format policy. There are types of intervention based on the level of loyalty to the past as follows: (Deek, 2017).

Renovation

Renovation in the word means rebuilding. The English translation and meaning of "renovation" are mending, rehabilitation, renewal, renovation repair. Habibi and Maqsoodi (2012) and Falamaki (2004) have translated the term Renovation for the word "Renovation". Renovation of inefficient urban structures is a medium-term measure that is the reconstruction or

revitalization of urban areas through the collaborative efforts of municipalities, owners of inefficient urban structures and other stakeholders. Renovation is done when the existing space has a suitable and effective function, but the relative wear and tear of the "body" has caused a decrease in its efficiency and effectiveness (Habibi and Maqsoodi, 2012: 81). The purpose of urban renewal is to improve the economic, social, spatial, natural and physical environment in and around the city.

Improvement

Improvement in the word means empowering again, empowering again and empowering again (Falamaki, 2004: 91). The English translation and meaning of "improvement" is: amelioration, amendment, betterment correct, correction, culture, improvement, melioration, refinement, reform. Examining different urban sources shows that improvement is considered as the same term as improvement in urban sources and architecture. However, when it comes to urban improvement, it includes a set of actions that, in the physical field, are consistent with the original model, to preserve and maintain the fabric and its elements, and in the non-physical field, it helps to promote its inner life (Shefa'i, 2016: 11). Improvement takes place when the relative wear and tear of the space has become acute in terms of functionality (Habibi and Maqsoudi, 2012: 18). This type of intervention is specific to contexts that have historical-cultural value, and intervention in these contexts requires compliance with the rules and regulations of the Cultural Heritage Organization (Abassi and Razavi, 2005).

Reconstruction

Reconstruction literally means rebuilding. Examining different urban resources shows that Reconstruction is considered as the same term as reconstruction in urban and architectural resources. But when it comes to urban reconstruction, it refers to a set of actions that, after destroying more than half of the work, a work is built again with a new face or completely in accordance with its original (Habibi and Maqsoodi, 2012: 16).

Each of these solutions involves a degree of intervention and manipulation in the existing urban context. The improvement of minimal intervention and manipulation in the existing physical condition and the renovation of a higher degree of intervention and manipulation and finally the reconstruction of the most manipulation in the physical condition of the worn and old urban fabric (Habibi and Maqsoudi, 2012: 62-63) (Table 2).

Table 2. Examples of industrial projects in Tehran and methods of using contextual components in improving the texture (Source: Authors, 2024)

Project name	Description	Pictures
Argo factory	*It was established in 1930 as an alcoholic beer company in Iran; *primary industrial use; *Remaining unused due to the government's ideological policies; *Purchase of Argo Factory by Pejman Foundation in 2015 to create a performance space and cultural center with emphasis on preserving the originality of the building and special respect for the old texture of Tehran; *The end of the renovation operation of the complex after three exhibitions in 2019 under the guidance of architect Ahmad Reza Shrikar; *Expansion of the renovated factory space from 460 cubic meters to 1860 cubic meters; *The current space of Argo factory includes courtyard, 5 galleries, cinematheque, cafe, art store, archive room, library, private office and institute office.	
Crystal and glass factory	*The first modern glass factory in Iran *Establishment year around 1930 AH *Has attractive and prominent architectural features in terms of industrial architecture *Using long metal chimneys and multi-story sheds next to dense workshop halls and beautiful old pipes and conveyors *Registration of this factory in the list of national monuments *Setting up an industrial museum	
Ali Nasab factory	*Located at km 17 of Karaj special road, in the vicinity of the license plate exchange center in the west of Tehran *Established year around 1950 AH *Creating a new additional production area next to the old ten-hectare hall of the factory with red bricks and wide skylights *Handing over production units to a private sector industrial company	
Traverse factory	*"Traverse" company, a producer of traverses and ready-made concrete parts, is one of these companies, which was established in 1998 and was handed over to the private sector in 1989 in line with the implementation of the policies of Article 44 of the Constitution, but after the handover, it faced many problems and was plagued by economic corruption. had been *Acceleration in the collection of linear worn tools from the length of the lines *Provision and support and continuous repairs of heavy machinery and engines and tools of maintenance workshops *Preservation and maintenance of the sanctity of railway lines and facilities within the protection area *Completion of current infrastructure management projects *Maintenance of technical lines and buildings	

Due to the combination and simultaneity of several reasoning strategies, this research uses theoretical summation instead of theoretical framework, which is as follows Figure 3.
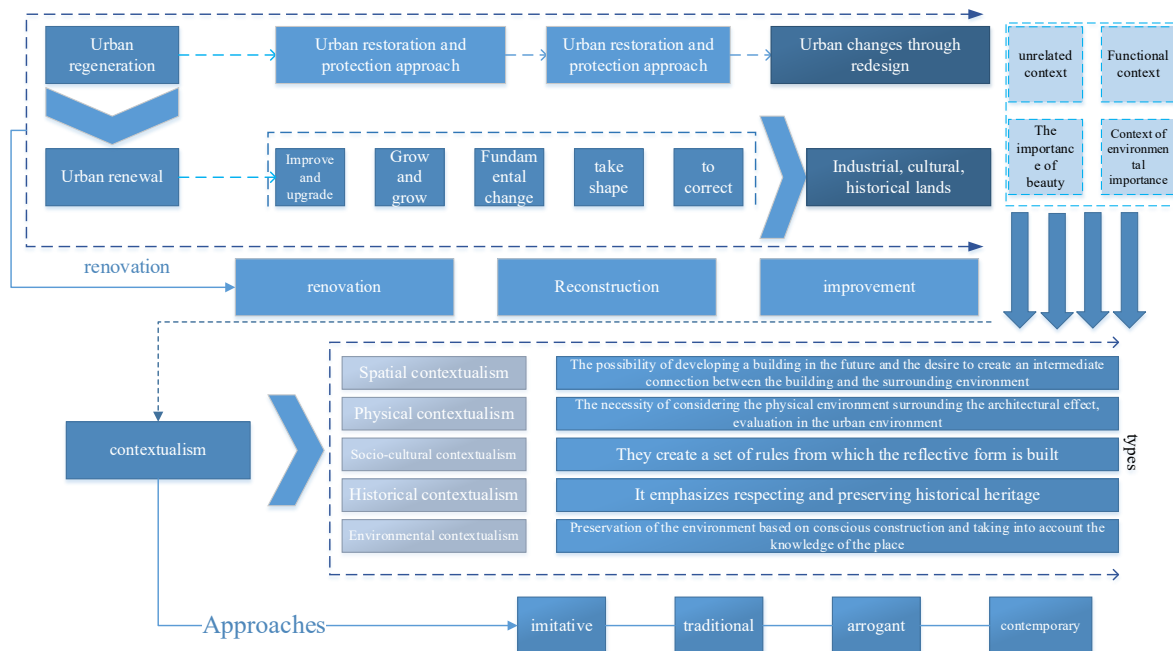
Figure 3. Theoretical summary of thematic literature related to title variables (Source: Authors, 2024)

Research Background

Qale Nuyi in 2022, in an article entitled "The Origins of the Thought and Method of Contextualism in urban planning, architecture, and the areas influencing these two from the 1960s until now" recognizes the evolution of "contextualism" in urban planning and architecture in this period (1960 to Kanon) with a review of its effectiveness from the opinions of thinkers in related fields. The present research method is descriptive and by explaining the thoughts of contextualism experts in the field of architecture and urban planning, as well as related and progressive fields such as philosophy and linguistics, which are the source of the thoughts of these two fields, it categorizes three main and distinct groups. Of the three categories identified, the first category is more influenced by the philosophy and linguistics of French thinkers; The second category, focuses more on history, culture, traditionalism, environmentalism, and fascism, and the third category, takes into account history, tradition, local culture, and environmentalism, has tried to coexist with the environment and strives to converge with the principles of sustainable development.

In 2022, in an article entitled "The Evolution of the Concept of Context and Contextualism in Architecture", Niayi and Eini Far explored the different aspects of this concept and how it affects the theoretical studies of architecture and urban planning. The research method is to analyze the content of related texts, extract the main keywords, and analyze their evolution over time. The analysis of the findings shows that there has always been a conflict of attention and lack of

attention to the context in modern, postmodern, and deconstruction schools. Also, the emphasis on stylistic features and formal profile in contextualism has expanded to the point that other aspects of contextualism have been neglected. Therefore, there is a need for a critical discussion plan and its theoretical development in the discourse of contemporary architecture. The results of the research can help advance the related theoretical issues by taking advantage of the evolution of the collected opinions and making the path of its practical use smoother in architectural design.

Zhou and Zhang, 2020, in an article titled "Contextualism and Sustainability: Beijing's Old Urban Revival" have pointed out that the idea of contextualism is emphasized in urban planning and the surrounding environment. This idea also refers to the sustainability of the landscape, which makes sense in the city. Most of the planning theories do not mention how the background of the city should be considered by urban planning.

Hosseini Nesab and Pouralikhani 2019 in the article "Social-cultural Contextualism: The Method of the Identity of the Architectural and Urban Planning of the studied example (New Shushtar City) based on Rappaport's Theory of Order" have investigated the example of modern urban development, New Shushtar city, and through the analysis of the obtained results in the form of pictures and tables has tried to clarify context-oriented design strategies with a socio-cultural approach. The upcoming research will use a qualitative type and descriptive-analytical research method. The method of accessing library and field information is completed through a case study.

In an article titled "Contextualism in the works of non-Iranian architects in the first Pahlavi period (Alborz and Iranshahr schools)" by Babaei and Khak Zand in 2018, the degree of adaptation to the context of these works was evaluated and it was concluded that two works were more or less influenced by It is from government systems and modernism, and one work, i.e. Iranshahr School, has paid more attention to the context and considered Iranian teachings. In this research, important criteria in contextualism related to functional dimension (dynamics, visual communication), physical dimension (proportions and human scale, spirit of place, relationship with surroundings and infrastructure), cultural dimension, and history (historical aspect and social values), The environmental dimension (the role of the designer and architectural plan) has been categorized and examined.

Sotoudeh & Wan Abdullah in 2018 in the article "Examination of the Appropriateness of the Design of the Historical Fabric of the City: from the Perspective of the Residents" have investigated the preferences of the residents of the historical fabric according to the conditions of the new interactive design and its relationship with the surrounding historical environment. The residents have become a part of the historical context of Shiraz city.

Demiri in 2017, in the article "Modern architecture as the intermediate masses of the historical context," investigated the policies and theoretical ideas in the case examples of the city of Athens. These examples are in the parts of the city where the new architecture is designed and implemented in a historical context, filling masses along the street facade in the vicinity of the old buildings.

Research Method

The research method in this study is a combination of qualitative and quantitative. It is also practical in terms of type. First, to extract the concepts of contextualism, a systematic review system with a library method was used to collect and categorize. This research lacks a theoretical framework (variable relationship) due to its hybridity and uses theoretical summation (summary of concepts and definitions). Then the first phase (qualitative) begins and the interview questions are extracted and formulated based on theoretical definitions and generalizations of the main research question. Then, with a snowball sample and starting with a targeted selection based on the entry criteria, a semi-structured interview is conducted with 28 experts. To facilitate coding based on description and interpretation, the coding system was used in ATLASTI8 software. In the coding system, each line of the text was carefully studied, and the hidden semantic content, underlying themes, and categories in that sentence were identified.

Entry conditions (sample entry criteria) as targeted sampling to conduct interviews are as follows;

- Be a member of the university faculty (at least an assistant professor).
- Have some examples of inefficient urban texture design.
- Have several articles on the components of contextualism or improvement of inefficient urban contexts
- Be proficient in the field of semi-structured interviews.

Table 3. People interviewed in this research

People interviewed	Number	Cumulative abundance	Accumulation percentage
Professors of architecture	11	39.3	39.3
Professors of urban management	7	25	64.3
Urban design professors	6	21.4	85.7
Urban planning professors	4	14.3	100
Sum	28	100	-

In quantitative sampling, based on the opinion of experts and the extracted variables, a closed questionnaire with five-point Likert answers was developed. The structure of the questionnaire includes questions related to the main question of the research; That is, the components of contextualism were in improving the dysfunctional tissues of the city of Tehran and in line with responding to it. To perform the calculations, a score of 5 for "very high impact" and a score of 1

for "very low impact" were considered by each expert, and to minimize the cost and time, a questionnaire among a random sample of the statistical population (engineers and designers) Architecture was distributed in the engineering system of Tehran. The sample size was selected using Morgan's table, which includes 384 people, which is the highest value in this table and was randomly distributed according to the population and the separation of men and women. The results are entered into the JMPSAS17 software and analyzed with inferential statistics. Reliability is obtained by measuring the internal agreement of the data and Cronbach's alpha, which is (0.811). The CVR formula is used to calculate validity and is 0.761 for 28 experts.

Case study

In this research, according to the research question, the industrial area of the city of Tehran has been selected according to the purposeful sampling, and the Azadi Innovation Factory has been selected as the best sample with a preference system (scoring between 1 and 10 without repetition) among 28 experts.

This factory with industrial and workshop use is one of the leading and successful factories in Tehran. Still, when it was moved to the outskirts of Tehran, its original and old space remained stagnant and turned into a ruin. In September 2016, HemAva company, in cooperation with Avatech, AvaGames, Shazan, Zavieh, Novardgah, and Novava companies, started the idea of designing and building a place to assemble this ecosystem;
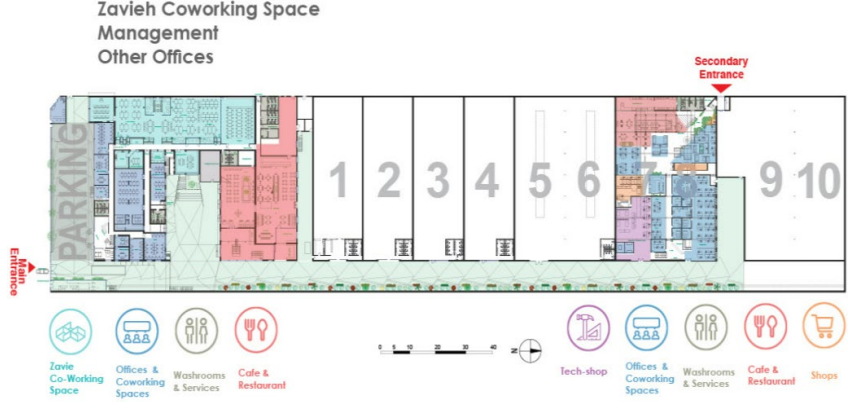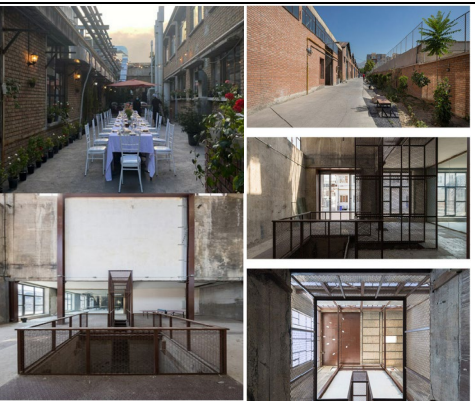
The restoration and restoration of the complex began with a local search for this type of activity and the selection of an abandoned factory near Tehran's Azadi Square. Establishment of the first innovation factory in the context of the Ama electrode factory (it was moved outside of Tehran due to environmental issues). This factory has ten sheds with an area of 10 thousand square meters and also an office building with an area of 4500 square meters. Also, by creating service units including a workspace, multiple meeting rooms, a conference hall, a sports club, a restaurant, and a coffee shop, it has made a suitable place for the concentration of the country's start-ups and risky investment companies.

The goal of setting up Azadi Innovation Factory is to create a platform to respond to the needs of entrepreneurs and those interested in setting up startups, which generally provides a unified space for all startup entrepreneurs, (Table 4). Among its other goals, we can mention better and centralized access for groups that were generally in smaller cities and migrated to Tehran in order to advance their goals in order to continue their activities in the startup ecosystem there. Among the services that this innovative factory provides to applicants, the following can be mentioned:

- Shared work space with team acceptance in accelerators
- Investing in teams entering acceleration programs at different stages of growth
- Leadership and guidance of startup teams by prominent mentors in factory accelerators

- Communication networks between factory member teams, large companies and policy makers for the growth of teams

Table 4. Before and after the re-creation intervention of the re-creation innovation in Azadi Innovation Factory (Source: www.innovationtour.ir)

Plan and section of the factory		
Facade	Before intervention	
	After intervention	
	After intervention	Before intervention
Interior space		
	After intervention	Before intervention

Findings

Qualitative findings

In the qualitative findings, the basis for conducting and multiple interviews is theoretical saturation in such a way that by repeating the results of the conducted interviews, the results are repeated. In this research, after the 28th interview, the data is repeated. In the first stage of open coding, a number of 48 codes are extracted, which after summarizing based on description and interpretation, the number reaches 36. They are classified into spatial, historical, environmental, socio-cultural and physical categories. The most prominent code obtained is related to paying attention to the details of the space with the number of 21 and the least prominent is related to the continuity of the shape of the historical texture with the number of 6. In the next step, a questionnaire with a Likert scale is compiled for each component.
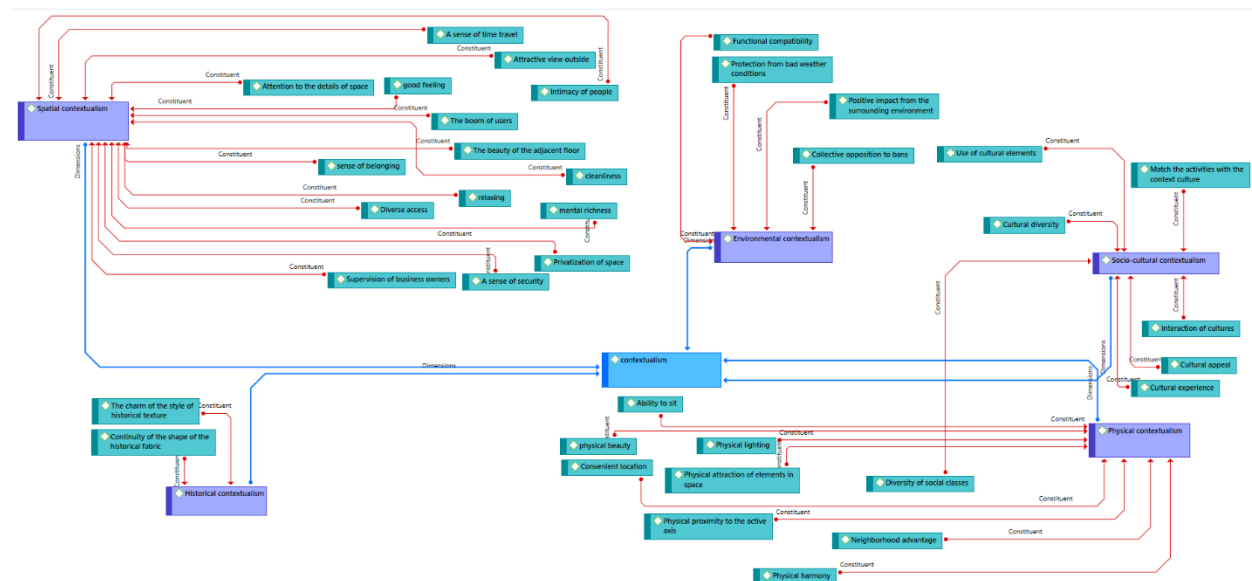

Figure 4. Open coding based on data reduction in ATLASTI software

Quantitative findings

Descriptive statistics

The results obtained from the general research questions show that 58% of the participants are men and 42% are women. Most of the participants' education is bachelor's degree with 52%, 26% master's degree and 12% specialized doctorate. The largest age group of the participants in this research is 47% between 18-22 and 26% between 22-26 and 27% between 26 and 30. The range 1 to 5 is used for unit conversion and numeration (very low to very high) and creates a range between (384 to 1920). The highest frequency of contextual components in improvement includes paying attention to the details of the space with a value of (1856) and the least related to collective opposition to prohibitions with a value of (106). In the modernization group, the positive influence of the surrounding environment with the value (1901) is the highest and the lowest is related to the collective opposition to the bans with the value (323). In the reconstruction group, the use of cultural elements with a value of (1906) is the highest and the lowest is related to collective opposition to prohibitions with a value of (651).
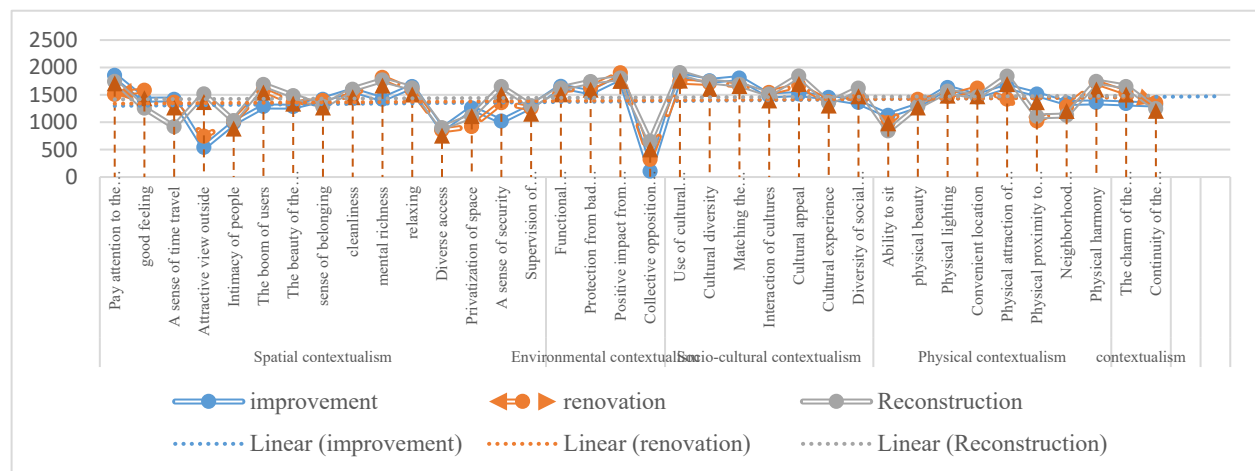
Figure 5. Frequency of effective contextualization components of environmental interventions

Inferential statistics

Correlation

Two-Sample Kolmogorov-Smirnov Test is used to check the parametric and non-parametric type of data.

Table 5. Kolmogorov-Smirnov test to check the effective contextual variables

P	Z Kolmogorov Smirnov	Standard deviation	average	Variable
0.281	0.798	228/3	25/44	Effective contextual variables in regeneration interventions

As can be seen in the Table 5, the Kolmogorov-Smirnov test is not significant (p=0.281) and therefore the components of contextualism variables are effective in regeneration interventions and non-parametric analyzes can be used for them. In the components of spatial contextualism, the sense of belonging has the highest correlation coefficient with a value of (0.981) and the lowest correlation coefficient is related to the supervision of business owners with a value of (0.246). the highest and the lowest are related to protection from bad climatic conditions (0.285). In the dimension of socio-cultural contextualism, the highest factor contribution is related to the use of cultural elements with a value of (0.921) and the lowest is related to the conformity of activities with the context culture (0.246). In physical contextualism, the component of physical beauty with a value of (0.922) has the highest correlation with other components and the lowest is related to the advantage of proximity with the value (0.262) in historical contextualism, the highest correlation is related to the attractiveness of the historical texture style with the value (0.881), the highest correlation and the lowest form of continuity is the historical texture with a value of (0.843).

Table 6. Contextual variables effective in regeneration interventions

Variables	Component	Correlation coefficient	Meaningful
Spatial contextualism	Good feeling	0.662	0.000
	A sense of time travel	0.406	0.010
	Attractive view outside	0.355	0.014
	Intimacy of people	0.646	0.012
	The boom of users	0.262	0.016
	The beauty of the adjacent floor	0.735	0.008
	Sense of belonging	0.981	0.006
	Cleanliness	0.843	0.007
	Mental richness	0.582	0.005
	Relaxing	0.274	0.004
	Diverse access	0.374	0.007
	Privatization of space	0.921	0.011
	Feeling safe	0.421	0.010
	Supervision of business owners	0.246	0.012
Environmental contextualism	Functional compatibility	0.821	0.014
	Protection from bad weather conditions	0.285	0.012
	Positive impact from the surrounding environment	0.675	0.007
	Collective opposition to bans	0.754	0.002
Socio-cultural contextualism	Use of cultural elements	0.921	0.004
	Cultural diversity	0.421	0.007
	Matching the activities with the culture of the time	0.246	0.011
	Interaction of cultures	0.524	0.010
	Cultural appeal	0.688	0.014
	Cultural experience	0.295	0.012
	Diversity of social classes	0.855	0.016

Physical contextualism	Ability to sit	0.742	0.008
	physical beauty	0.922	0.006
	Physical lighting	0.662	0.007
	Convenient location	0.406	0.005
	Physical attraction of elements in space	0.355	0.004
	Physical proximity to the active axis	0.646	0.007
	Neighborhood advantage	0.262	0.011
	Physical harmony	0.735	0.010
Historical contextualism	The charm of the style of historical texture	0.881	0.012
	Continuity of the shape of the historical fabric	0.843	0.014

Regression

To check the amount of factor contribution, it is necessary to use criterion variable and predictor variable. In the correlation matrix, it is compiled from the multiple models by guessing the type of linear or non-linear relationships. As can be seen, the relationships in the dimensions of contextualism do not have linear relationships, and multivariate regression is used for this purpose.

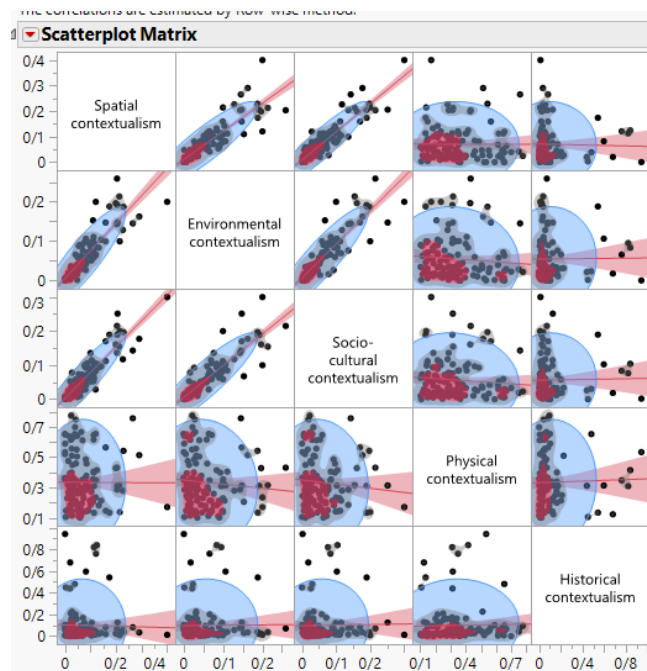
Figure 6. Correlation matrix between variables

Based on the regression results, it is determined that the highest factor load in the components of the dimension of spatial contextualism is related to good feeling and sense of security with a

value of (1.000) and the lowest factor is related to the beauty component of the adjacent axis with a value of (0.343). In the dimension of environmental contextualism, the highest coefficient of determination is related to the positive influence of the surrounding environment with a value of (0.695) and the lowest is related to collective protection with prohibitions with a value of (0.356). In socio-cultural contextualism, cultural attractiveness with a value of (0.951), the highest factor is related to cultural diversity with a value of (0.306). In physical context, the highest factor contribution is related to physical beauty and physical lighting with a value of (1.000) and the lowest is related to appropriate positioning. with a value of (0.511). In historical contextualism, the highest factor contribution is related to the continuity of the form of the historical context with a value of (0.815) and the lowest is related to the attractiveness of the style of the historical context with a value of (0.651).

Table 7. Multivariate step-by-step regression of the effective components of contextualism in regeneration interventions

Variables	Component	Coefficient of determination	F	B	β	t	Meaningful
Spatial contextualism	good feeling	1/000	501/318	1/000	0.762	571/44	0.021
	A sense of time travel	0.820	801/544	1/000	0.372	365/31	0.014
	Attractive view outside	0.789	857/369	1/000	0.872	255/31	0.022
	Intimacy of people	0.658	506/710	1/000	0.685	479/58	0.011
	The boom of users	0.815	289/658	1/000	0.597	982/21	0.011
	The beauty of the adjacent floor	0.343	526/689	1/000	0.436	134/11	0.012
	sense of belonging	0.895	314/278	1/000	0.852	425/24	0.001
	cleanliness	0.756	586/784	1/000	0.665	132/23	0.004
	mental richness	0.723	695/174	1/000	0.213	121/48	0.011
	relaxing	0.745	261/824	1/000	0.425	963/47	0.017
	Diverse access	0.795	316/512	1/000	0.414	564/43	0.16
	Privatization of space	0.355	255/984	1/000	0.421	448/49	0.015
	Feeling safe	1/000	250/518	1/000	0.421	214/15	0.071
	Supervision of business owners	0.913	211/159	1/000	0.615	216/22	0.015
Environmental contextualism	Functional compatibility	0.522	588/453	1/000	0.424	552/22	0.021
	Protection from bad weather conditions	0.685	255/439	1/000	0.423	354/18	0.038

|						
	Positive impact from the surrounding environment	0.695	565/325	1/000	0.454	341/32	0.002
	Collective opposition to bans	0.356	551/825	1/000	0.341	324/23	0.003
Socio-cultural contextualism	Use of cultural elements	0.425	133/746	1/000	0.578	839/28	0.021
	Cultural diversity	0.306	655/145	1/000	0.514	581/48	0.014
	Matching the activities with the culture of the time	0.723	325/659	1/000	0.542	566/48	0.022
	Interaction of cultures	0.689	333/544	1/000	0.541	698/29	0.011
	Cultural appeal	0.951	154/448	1/000	0.654	214/32	0.011
	Cultural experience	0.869	183/532	1/000	0.221	807/16	0.012
	Diversity of social classes	0.661	425/186	1/000	0.521	458/13	0.001
Physical contextualism	Ability to sit	0.581	441/139	1/000	0.522	458/36	0.004
	physical beauty	1/000	288/458	1/000	0.524	542/20	0.011
	Physical lighting	1/000	239/488	1/000	0.619	310/39	0.017
	Convenient location	0.511	369/225	1/000	0.162	725/28	0.16
	Physical attraction of elements in space	0.542	614/255	1/000	0.902	811/26	0.015
	Physical proximity to the active axis	0.672	501/318	1/000	0.532	231/23	0.071
	Neighborhood advantage	0.820	801/544	1/000	0.852	128/21	0.015
	Physical harmony	0.789	857/369	1/000	0.725	821/65	0.021
Historical contextualism	The charm of the style of historical texture	0.658	506/710	1/000	0.911	316/55	0.038
	Continuity of the shape of the historical fabric	0.815	289/658	1/000	0.147	411/43	0.002

Other to increase the effectiveness of regeneration interventions and also to increase the intensity of the factor effect. Based on the findings, it is clear that the historical and physical components have a stronger causal relationship with each other, and social-cultural contextualism, environmental contextualism, and spatial contextualism also have a greater tendency with each other, as well as the intensity of the factor effect individually in the questionnaires. It was the highest for each person in spatial and environmental contextualism. Also, the size of the larger individual effect in 3D modeling based on spatial spotting indicates the same.

Table 8. PN modeling of the effective contextual variables of regeneration interventions
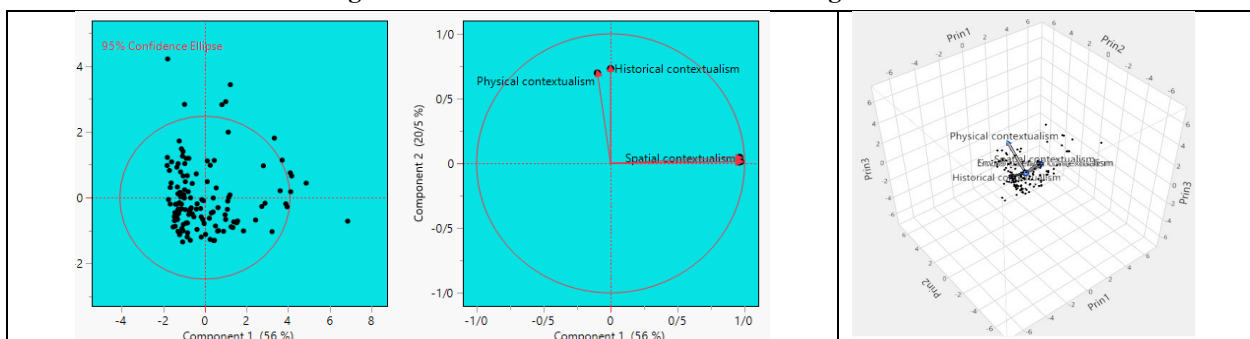
At the end, a graphical correlation is taken between different dimensions in a pairwise manner and it is determined that the spatial components of contextualism, environmental and socio-cultural components can be more than 0.7. The R2 format is displayed and other dimensions (such as physical and socio-cultural components) do not follow each other.

Table 9. Graphical correlation between the dimensions with the highest predictability from each other

R2=0.778	R2=0.834
R2=0.008	R2=0.798
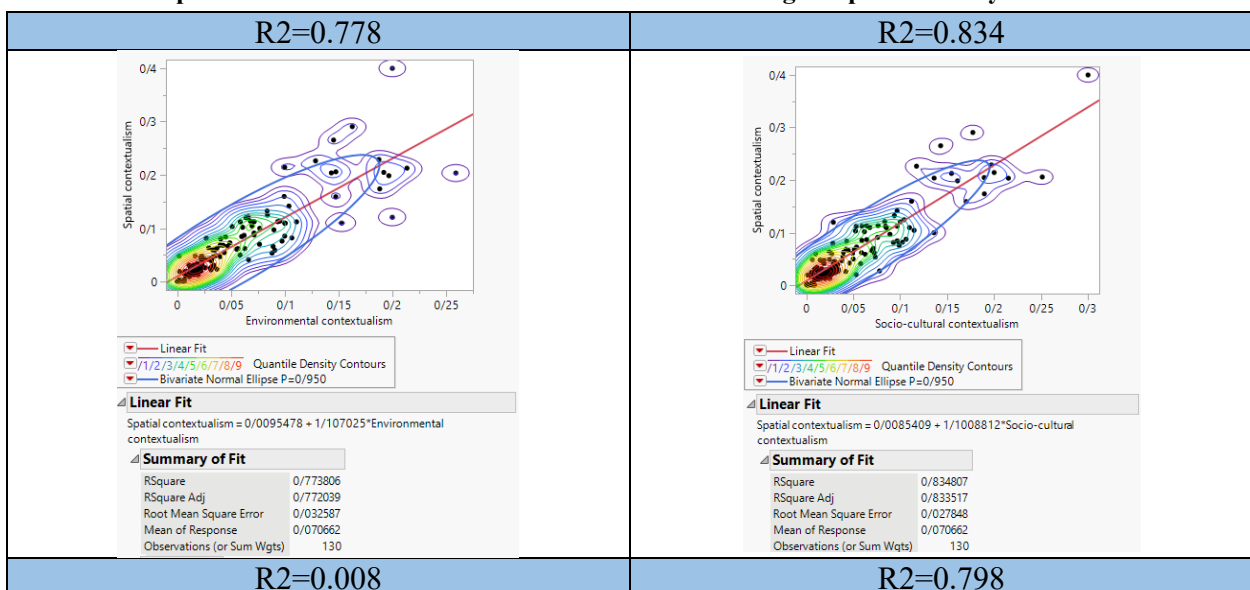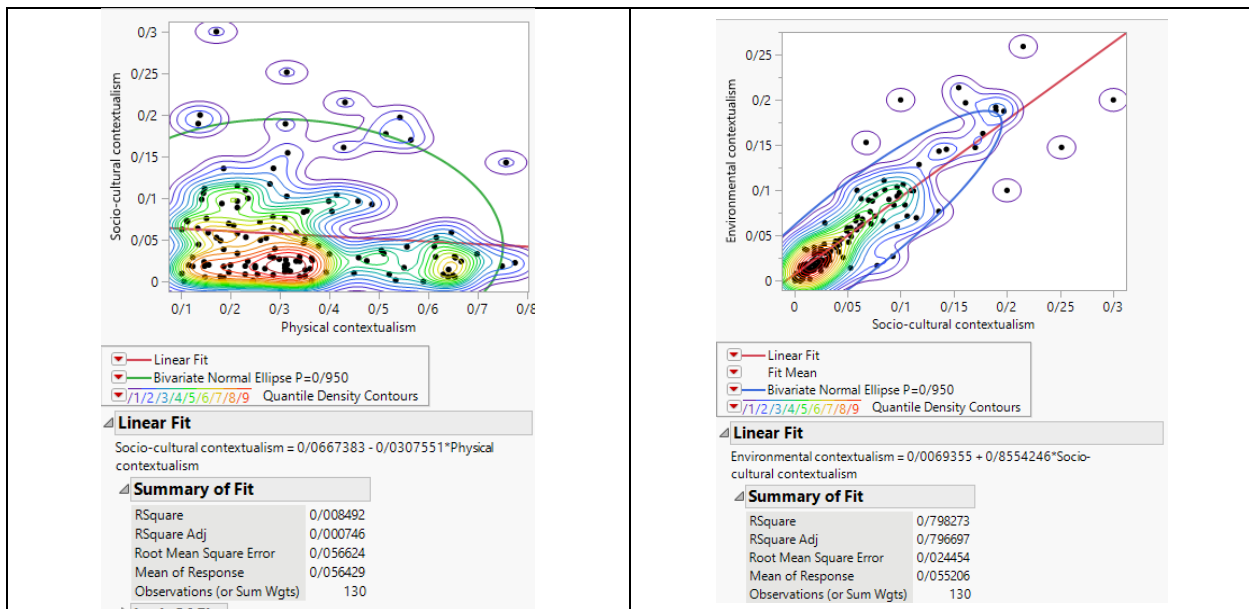
Discussion

This research has emerged with the aim of numerically comparing the components of contextualism for the achievement of regeneration interventions. First, the number of extracted codes and the number of spatial and physical components, as well as the presence of more prominences in these two dimensions, emphasize this issue. Descriptive findings in statistics indicate that improvement, reconstruction and renovation can be considered interchangeably due to the similarity in numerical distribution and following moving average and can be considered as regeneration interventions. The difference between descriptive and inferential statistics indicates that the intensity of the effect should be explained based on inferential findings. For the explanatory conditions of the independent components in the criterion variable, correlation and regression should be used. The correlation between the components shows that the spatial components of contextualism have a greater ability to increase other components to improve environmental regeneration interventions. Also, due to being positive in all dimensions, the correlation results indicate the synergy of a component in the matching application. Regression results showed that paying attention to non-objective aspects in the space (renovation, improvement, renovation) can have the greatest impact in regeneration interventions along with paying attention to local and cultural aspects as well as the type of beauty at night. PN modeling and pairwise correlation show that environment, space, community and culture follow each other in regeneration interventions based on context.

According to the research findings, it can be concluded that in the dimension of spatial contextualism, the most influential component is the element of good feeling and feeling of security. This is because in this factory, preserving the industrial identity, changing the function

of the old spaces, and adapting them to meet the needs of today's users with the least interference and destruction in the existing situation have been considered. Also, in this factory, other spaces meet the needs of the employees during the day and their working hours, so this complex brings them the necessary comfort and the employees feel good and feel safe. In the dimension of environmental contextualism, the most determining coefficient is related to the positive influence of the surrounding environment. The reason for this is that the main courtyard of the complex, which is located all around the complex, has turned into the main plaza of the complex, which is a place to be transformed into a collective open space, which, in addition to resting the staff and users of the complex, can be used during events. The big one is also a meeting place. The staircase of this plaza in the Azadi Innovation Factory complex is designed in such a way that it is in harmony with the concept of the symbol of the complex.

This factory has 10 sheds with an area of 10,000 square meters. Among these ten sheds, sheds number seven and eight are also a suitable platform for innovation in the specialized areas of architecture, and urban design, which provide an opportunity for interaction by providing a suitable workspace, shared workspace, and space for interactions and social events. Dialogue, flourishing, and development of innovative ideas in the form of acceleration services for start-up teams in the field of architecture in Azadi Innovation Factory. As a result, in socio-cultural contextualism, cultural attraction is the most effective component. In the physical context, the biggest factor is related to physical beauty and physical lighting. The sharp and converging surfaces of the two sides of the factory, in addition to intensifying the perspective with the triangulation form of the floor, are also in harmony with the concept of peak and acceleration. This physical form of the pages intensifies the sense of dynamism and speed.

Among the actions of the builders and restorers of this old and abandoned factory are master plan design, initial restoration, structural strengthening, innovation factory infrastructure design, and implementation, as well as interior architecture design and implementation along with light design, furniture lighting, interior design of public and private spaces.

Conclusion

Today, Azadi Innovation Factory has used its inner potential and has been able to modernize this building and revive it as a factory to produce new architectural ideas, and it has also taken steps to connect to the industry. In reading a valuable historical work, several factors are of great importance. These factors will be effective in planning a powerful work, and you can't step into the arena by ignoring these design details. Because its content will appear empty. The limits and general ideas of the plan must be clearly defined. The reason for the current situation of Azadi Innovation Factory and the plan it has advanced is also very valuable. Because in the reconstruction of this factory, different dimensions and approaches have been considered. One of

the most widely used of them is the attention to context and contextualism, which has improved the objective and non-objective aspects of the Azadi Innovation factory. The regeneration of this factory has caused the old spaces of the factory have change quickly and turn into startup and innovation spaces. According to the findings of the research, the highest factor load in the components of the dimension of spatial contextualism is related to good feelings and feelings of security, in the dimension of environmental contextualism, it is related to the positive influence of the surrounding environment, in socio-cultural contextualism, cultural attractiveness and in the context Physical orientation is related to physical beauty and physical lighting. Based on these results, the following are suggested:

- Paying attention to creating different feelings in renovated spaces (liveliness, belonging, etc.) that can increase the emotional bond in the environment. This can be associated with people's recollection based on the use of multiple senses
- Creating security in spaces different from each other in such a way that each space, despite the visual and spatial links, has security in the physical and visual areas in its heart, so that the unity of the spaces can be strengthened in it.
- Paying attention to physical aesthetic aspects in re-creation to create visual appeal and inviting the audience and pay attention to physical aspects at night by lighting the components of building forms.
- Using different cultural elements according to the types of culture of the society to create a spatial metaphor and pay attention to the atmosphere of each region

Author Contributions

All authors contributed equally to the conceptualization of the article and writing of the original and subsequent drafts.

Data Availability Statement

Not applicable

Acknowledgements

The authors would like to thank all participants of the present study.

Ethical considerations

The study was approved by the Ethics Committee of the Islamic Azad University, Central Tehran Branch. The authors avoided data fabrication, falsification, plagiarism, and misconduct.

Funding

Conflict of interest

The authors declare no conflict of interest.

References

Abbasi, H., & Razavi, R. A. (2016). *Designing an economic conceptual model for the revival and reconstruction of the fabric, the worn-out collection of articles on construction in the capital*. University of Tehran.

Almodaresi, S. A. (2020). Rehabilitation and Evaluation of Chaharmahal and Bakhtiari Province Land use to Centralized Tourism Attraction. *International Journal of Applied Arts Studies (IJAPAS), 4*(4), 67-78.

Almusaed, A. (2011). *Biophilic and Bioclimatic architecture: Analytical therapy for next generation of passive architecture*. Springer, London.

Babaei, S., & Khak Zand, M. (2017). Contextualism in the works of non-Iranian architects in the first Pahlavi period (Alborz and Iranshahr schools). *Journal of Iranian Architectural Studies, 14*, 171-189.

Bach, K. (2005). The Emperor's New 'Knows'. In *G, Preyer, & G, Peter (Eds.), Contextualism in philosophy: Knowledge, meaning and truth* (pp. 51-89), New York, USA: Oxford University Press.

Beatley, T. (2011). *Biophilic cities: Integrating nature into urban design and planning*. Island press. Washington.

Brolin, B. (2012). *Contextual architecture*. Khak Press, Tehran.

Deek, K. (2017). *City branding: Theory and cases*. Palgrave Macmillan.

Demiri, K. (2017). *New Architecture as Infill in Historical Context*. National Technical University of Athens: Architecture and Urban Planning.

Dorsey, K. (2003). *Contextualism: An Explanation and Defense*. In Greco, J. and Sosa, E., (eds), The Blackwell Guide to Epistemology. Blackwell.

Falamaki, M. M. (2004). *A journey through the experiences of urban restoration from Venice to Shiraz*. Tehran, second edition, Faza Publications.

Habibi, M., & Maqsoodi, M. (2012). *Urban restoration: definitions, theories, experiences, international charters and resolutions, urban methods and measures*. Tehran University Publications.

Hemmati, A., Mosalman Yazdi, H., Sadeghian, A., & Sherafat, A. (2024). Investigating the Potential and Benefits of Using Building Information Modeling (BIM) in the Life Cycle of Construction Projects. *International Journal of Applied Arts Studies (IJAPAS), 9*(1), 69-84.

Hosseini Nesab, S., & Pouralikhani, M. (2019). Social-cultural Contextualism: The Method of the Identity of the Architectural and Urban Planning of the studied example (New Shushtar City) based on Rappaport's Theory of Order, *National conference of fundamental research in civil engineering, architecture and urban planning*, 1-14.

Kim, J. Y. (2015). Urban Regeneration Utilizing Art: A Case Study of the Samlye Art Village, Korea. *International Journal of Multimedia and Ubiquitous Engineering, 10*(11), 337-342.

Ludolow, P. (2005). Contextualism and the new linguistic turn in epistemology. In G, Preyer, & G, Peter (Eds.), *Contextualism in philosophy: Knowledge, meaning and truth*. USA: Oxford University Press.

Mahdavinejad, M., Bamanian, M., & Malay, M. (2010). Context oriented process of architectural experience during 2010-2011, *Naqsh Jahan Journal, 1*, 21-34.

Moayedfar, S., Masihi, S., & Esteghlal, A. (2017). Regeneration of Distressed Areas of the Central District of Ahvaz City via the Sustainable Development Approach. *International Journal of Applied Arts Studies (IJAPAS), 2*(2), 7-26.

Naghavi, P. (2018). *Dimensions, physical objects and modeling of context-oriented architectural process*. Doctoral dissertation, architecture department, Faculty of Arts, Isfahan University.

Niayi, E., & Eini Far, A. (2022). The Evolution of the Concept of Context and Contextualism in Architecture. *The 9th national conference of modern studies and research in the field of geography, architecture and urban planning of Iran*, 1-7.

Pour Ahmad, A., & Vafaei, R. (2016). *Study of the functional developments of Kerman market*. Tarbiat Modares University.

Pynn, G. (2016). *Contextualism in epistemology*. Retrieved from: https://www.oxfordhandbooks.com/view/10.1093/oxfordhb/9780199935314.001.0001/oxfordhb-9780199935314-e-12

Qale Nuyi, M. (2022). The Origins of the Thought and Method of Contextualism in urban planning, architecture, and the areas influencing these two from the 1960s until now. *Geospatial research, 7*(1), 5-28.

Rappaport, A. (1990). *History and precedent in environmental design*. Plenum Press, London.

Recanati, F. (2012). *Pragmatic Enrichment*. In Russell, G. and Fara, D. G., (eds), Routledge.

Rezaei Rahimi, M., Zakerian, M., & Nazari, A. (2020). Strategic Planning for Eroded Urban Textures with an Emphasis on Public Participation (Case Study: Neighborhoods of Baghe Melli, Agha Hakim Nasrollah, Shadmand and Shahid Yazdani of Shahreza City). *International Journal of Applied Arts Studies (IJAPAS), 4*(2), 33-48.

Saif al-Dini, F. (2013). *Urban freedom in human scales*. Century Architecture Publishing House, Tehran.

Sajjad Zadeh, H., & Zolfi Gol, S. (2014). Urban design, in the re-creation of traditional neighborhoods with a stimulating development approach, a case example: Kalpa Hamadan neighborhood. *Amayesh Mohit Journal, 8*(31), 147-171.

Shafaei, S. (2016). *Guide to Identify Intervention in Dilapidated Fabrics (Approved by the Supreme Council of Urban Planning and Architecture of Iran)*. Tehran: Ide Pardazaan Publications.

Soltani, M. (2012). Searching for the meaning and place of context in different approaches to architecture. *Niaresh Journal, 1*(2), 10-21.

Sotoudeh, H., & Wan Abdullah, W. (2018). Evaluation of fitness of design in urban historical context: From the perspectives of residents. *Frontiers of Architectural Research*, 85-93.

Taban, M. (2020). *Urban wall design with an emphasis on the contextual orientation of the mosque neighborhood, Dezful, Iran*. Master's thesis, field of urban planning, urban design, Jundishapur University of Technology, Dezful.

Tefagh, K., & Yarmand, M. (2019). Designing the Recreational Cultural Complex Park of Janoobe Yazd with an Emphasis on Preserving the Industrial Heritage Values. *International Journal of Applied Arts Studies (IJAPAS), 3*(3), 35-44.

Turner, L., & Millimian, R. (1996). Atmospheric effects on shopping behavior: A review of the experimental evidence. *Journal of Business Research, 49*(2), 193-211.

Veldpaus, L., & Roders, A. (2013). Urban heritage: Putting past into the future. *The Historic Environment, 4*(1), 3-18.

Venturi R., & Scott Brown, D. (2000). *Architecture as Signs and Systems for a Mannerist Time*. (Cambridge: Harvard UP, 2004), 1.

Zhang, L., & Zhao, S. (2009). City branding and the Olympic effect: A case study of Beijing. *Cities, 26*(2), 245-254.

Zhou, S., & Zhang, S. (2020). Contextualism and Sustainability: A Community Renewal in Old City of Beijing, *Sustainability*, 746-766.

Identification and Analysis of Objective Time in Historical Monument Conservation and Restoration Scientific Studies

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Article Info	ABSTRACT
	In this article, time is recognized as a fundamental factor in the scientific and theoretical discussions of conservation and restoration. Based on theories presented from ancient to contemporary times, time is a phenomenon with scientific and philosophical dimensions that must be analyzed from various aspects for its understanding and identification. Thus, in this research, time is identified through a qualitative approach with phenomenological strategy, and while introducing its various dimensions, the objective or tangible aspect of this phenomenon in scientific studies of conservation and restoration is elaborated. Accordingly, time, in its scientific and objective dimension, manifests itself through continuity and interdependence with change and transformation, alongside the processes of deterioration of monuments and the studies of time measurement in human awareness. Therefore, time measurement experiments and determining the historical period of a monument, as well as the scientific analysis of deterioration processes to understand the altered layers of the surface in various things, represent the scientific efforts in conservation and restoration to identify the objective phenomenon of time in monument and preserve them.

Introduction

Time and the way of human understanding of it is one of the fundamental scientific and philosophical issues, which theories have been presented over the centuries. At the beginning of the 20th century, Einstein's theory of relativity brought modern man to change his attitude about the world, and the progressive minds of the world, who had a great desire to discover the secrets hidden in nature, welcomed the writings of this great scientist. This important theory removed time and space from being absolute, unlike the previous concepts, and defined and determined the concept of event. According to this theory, four-dimensionality is necessary to know the world. Determining a position in addition to the Cartesian coordinates actually requires four measurements, and these measurements do not establish the position of the object in the place, but rather an event in the place, thus the concept of the event or The event replaced material objects and space-time replaced space and time, which means that encountering material objects is actually encountering events, not just a mass made of matter; If, according to the previous theories, it was possible to imagine a number of objects in a single moment and ignore it because the time was the same for all of them, now we have to face the objects -or in more correct terms-events; Time also identified and comprehensively analyzed the object. Therefore, the world that this theory introduces to us is the world of events, a place inside which matter is moving at a certain time, and objects are actually events that happened at their own time. Matter, space, time and motion are the building materials of the universe.

Time is the foundation of the existential nature of material. The theory tells us that time is not a different matter. All objects are, in fact, time events or events in their space-time. Space-time forms the place of the actual texture of events or objects (Russell, 1961: 104-233).

Based on this, by reflecting on the fundamental concept of events in this theory, all sciences that deal with the study of various works and objects, including artworks from different historical periods to contemporary ones, are not only faced with mere masses made of various materials but are scientifically engaged with an event that has a real and thoughtful relationship with time. The question is, what is the nature of time that is measured in these studies, and how is it identified? This article analyzes this question using a phenomenological approach. In the study of various works, a comprehensive understanding of time reveals the very essence of artistic works, highlighting the importance of recognizing time in the study of these works. Time is a phenomenon with its own specific aspects, and this article focuses solely on its objective facet.

Time is the foundation of the existential nature of matter. This theory tells us that time is not a separate and distinct subject from matter, and that all objects are, in fact, temporal events or occurrences in their own right, forming the actual context of these events (objects) (Russell, 1961: 104-233). Accordingly, by reflecting on the fundamental concept of events in this theory,

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all sciences that engage with the study of various works and objects, including artworks from different historical periods to contemporary ones, are not only confronted with mere masses made of various materials but also with events that have a real and thoughtful relationship with time. The question arises: what is the nature of time that is measured in these studies, and how is it identified? This article analyzes this question using a phenomenological strategy. In the study of various works, a comprehensive understanding of time reveals the very essence of artistic works, highlighting the importance of recognizing time in these studies. Time is a phenomenon with its own specific aspects, and this article focuses solely on its objective facet.

Research Background

Humans perceive the passage of time through changes in their surrounding environment; however, their understanding of time differs from their understanding of space. Considering the dimension of time, objects are essentially events, and human temporal perception is dependent on the understanding of these events. Humans have the mental ability to perceive the sequence of events as before and after, thus grasping the passage of time (Horel, 1998: 156-171). Accordingly, time is recognized in the form of events. Additionally, our knowledge of the past is not based solely on the mind but rather involves the use of historical-cultural evidence and remnants left by predecessors. Thus, one can gain insights about the past in the present without being in that time (Campbell, 1997: 105-118), because humans possess special cognitive mechanisms that enable them to understand time. This understanding manifests as mental simulations of the future and representations of the past through memory and recollection, particularly in the study and recognition of historical and cultural monuments. The perception of the passage of time relates to changes in surrounding objects, and the way humans experience time is tied to their understanding and analysis of the concept of events. Exploring this topic, especially regarding human cultural monuments across different historical periods, can be a subject of reflection (Le Poidevin, 2015: 1-9).

In this context, Matthew Davidson addresses the topic of time and four-dimensionality in artworks by discussing the concept of time within them. His key points revolve around the events concerning the temporal aspects of physical objects. The author explicitly states that no one can conduct a deep scientific examination and study of the materiality of objects without also investigating time because time is in direct relation with physical objects and is constantly connected to them (Davidson, 2004: 17-33). Therefore, in scientific studies of conservation and restoration, a comprehensive understanding of the time aspect of the artwork holds special significance, which this article analyzes focusing on its objective aspects.

Methodology

This research adopts a qualitative approach and an inductive reasoning framework, utilizing a phenomenological analysis strategy. It involves the coding and logical arrangement of qualitative data derived from scientific theories. Phenomenology gained recognition in the twentieth century through the works of Edmund Husserl in Germany, advocating for a return to the things themselves, and in France through Maurice Merleau-Ponty. Husserl presented phenomenology as a means to carry out clear and justifiable research stages (Primozic, 2009). Phenomenology represents a fundamental movement in the twentieth century and is recognized as the philosophy of that era. Its aim is to provide a clear perspective for understanding the meanings of research questions or to approach philosophical issues with a phenomenological lens (Glendinning, 2008). In essence, it serves as a subjective method to lend scientific legitimacy to philosophy (Wall, 2015: 14), and according to Heidegger, it defines how research should be conducted (Heidegger, 2016). However, the manner in which questions are posed in research centered on the phenomenon of time is itself a fundamental issue. Regarding time, it is essential to discern what question to ask and how to articulate it, followed by contemplating ways to answer it (Bardon, 2016: 9). When inquiring about time, one should focus on all dimensions of the issue and phenomenological reveal its manifestations in human consciousness (Heidegger, 2008: 61-62). The main inquiry of this article is analyzed based on prominent scientific theories. The concepts presented aim to address the objectives of the research in an inductive manner, delving into the meaning relevant to answering the fundamental questions of the study (Cresswell, 2005; Torrance, 2008).

The entirety of phenomenology, or its ultimate meaning, can be viewed as a quest to discover the implicit form of a concept, a determination, or a thought (Levinas, 2013: 119). According to Husserl, phenomenology examines the intertwined nature of consciousness and the phenomenon under study. The realm of phenomenology is limitless, making it impossible to confine it within a specific science. Thus, this article approaches time through a phenomenological lens, delving into its nature as something that is apparent and tangible, yet, in reality, is a concealed phenomenon requiring reflection for proper understanding. The discussion will detail the phenomenological recognition and its function as the fourth dimension of objects in the conservation and restoration of various types of monuments throughout different periods, emphasizing a process that directly engages with objects.

In proposing a phenomenological method, certain steps are taken that involve returning to the essence of the phenomenon to intuitively analyze it from various perspectives and modes of emergence. Observing how the phenomenon manifests in human consciousness is a stage in phenomenology that culminates in the awareness of the phenomenon, which is a key phase within Husserl's phenomenology (Spiegelberg and Schumann, 2013: 984). This article solely

focuses on one aspect of how time manifests in human consciousness within the context of conservation and restoration of monuments, emphasizing its objective dimension and highlighting its role as a fundamental aspect of the physical dimensions in this process.

Meaning and Concept of Time

The concept of time has been a subject of extensive study by thinkers for thousands of years. Plato was one of the first philosophers to address the issue of time in his dialogue "Timaeus." Within the framework of his theory of Forms, he considered time to be limited to the natural world and a moving image of eternity, which is continuously in motion according to numerical multiplicity. For him, time was related to ordinary physical movements, such as the movements of celestial bodies, which serve as suitable tools for humans to measure time (Weinert, 2013). However, the first philosopher to provide a comprehensive explanation of time was Aristotle, who dedicated parts of his book "Physics" to the subject. Like Plato, he associated time with number and movement, defining it as "the number of movement in respect of before and after" (Aristotle, 2014: 192).

Humans perceive the world around them through their senses. They see colors, hear sounds, and feel softness and roughness. However, a concept like time cannot typically be perceived through the five senses. The perception of time requires something beyond the ordinary sensory abilities of humans, and it seems strange to say that the passage of time can be seen or heard. Nevertheless, the passage of time is recognized through changes in human thought patterns. Time is identified through indirect perception of changes in other things around us (Le Poidevin, 2015).

The human capability to comprehend the issue of time manifests in various ways; "the past, present, future, change, transformation, and the concept of events are different forms that the problem of time appears in human awareness" (Smart, 1968: 17). In general, the theories proposed by various thinkers regarding time can be categorized into three main groups: idealism, realism, and relativism. This article focuses on realism and examines the objective (or external) aspect of time.

Bertrand Russell considers the continuous perception of movement and change, which leads to awareness of time based on momentary understanding, as real. He claims that humans genuinely understand change in the exact sense of the word. Edmund Husserl views the act of awareness in human experience as continuous. Humans become consciously aware of time through their ability to perceive change and transformation in a real and direct manner. Accordingly, realists regard time as an objective, real entity and a container for events. They hold the opposing view to idealist thought, believing that change and movement occur in reality independently of human perception and outside of mental interpretations, and that time passes irrespective of human

existence. Humans experience changes directly and objectively; therefore, they can have a realistic perspective on time (Bardon, 2016: 14).

Each of the theories presented by various thinkers contains important and noteworthy points regarding time. However, the common essence of different perspectives on time is that what is referred to as time pertains to the measure of change and transformation that occurs due to movement. The universe is in a state of transformation and change because of motion, and time is considered the measure of this movement and change (Russell, 2015).

Consequently, when dealing with objects in the field of conservation and restoration, the material used in the work is continuously linked with time. The artwork is inherently temporal because it possesses a material structure, and within this material, there is an organized and ongoing movement at the atomic level. From the perspective of realistic theories that regard time as an objective phenomenon, time is related to movement.

By considering time objectively, based on the inherent temporality of the material of the work, specific changes in the material can be taken as criteria. By measuring these changes over a determined duration with the help of accurate instruments and various experimental methods, the precise age of the artworks can be estimated. This plays a significant role in determining the period of the work in the technical studies of conservation and restoration (Liritzis et al., 2013).

The time often examined and measured in archaeological studies is objective or external, which is measurable and identified through timing methods. Depending on the type of material of the artwork, various methods for measuring the age of the piece exist. For instance, thermoluminescence dating is often used for mineral materials, carbon-14 dating for organic materials, and dendrochronology for determining the age of wooden monuments. Overall, any method based on studies of changes in the material of the artworks falls under the category of methods for revealing the objective time of these works.

In each of these methods, the foundation relies on the precise analysis of a change. Every change is dependent on movement, even the smallest movement at the molecular scale within the material, which leads to a change in the artwork material. Since time is a measure of movement, it can serve as a basis for measuring the age of the artwork. As the composition of a work changes over time, its age can be determined precisely or relatively, depending on the selected methods (Caple, 2006: 69).

Objectivity and Time

The concept of time, arising from the phenomenon of movement, is objective and represents the primary understanding of time that aligns with the structures of classical mechanics and quantum mechanics. The passage of time is characterized by the occurrence of events in an unpredictable and creative manner within an irreversible historical context; time has a unique

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historicity and irreversibility. The universe is in a state of change, and time stems from these changes and organized movements. Plato and Aristotle are prominent supporters of this idea, and many scientists have followed their views from their time to the present day.

In this perspective, "time is a kind of number, the number of changes in terms of before and after." From Aristotle's viewpoint, time is a measurable unit and is used to describe changes. When considering time as dependent on movement and change, change is a real phenomenon that can be measured in time units (Weinert, 2013).

In other words, according to Aristotle's view, "time cannot exist without change; time is a kind of number," and this number represents continuous movements. This dependency is profound (Franz, 1974: 19). The dependency of time on movement relates to the laws of physics, and in any subject where movement and change are discussed, time is also a consideration. This time also has a spatial meaning because movement and change occur in anything that is tangible and measurable. From macroscopic measurements in nature to movement and change within substances at the microscopic, atomic, and molecular scales, Galileo, in his work, discussed the relationship between time and movement. This relationship is essentially the measurement of movement with time; time, according to Newton, measures uniform rectilinear motion, which covers equal distances in equal times.

Time and movement are so deeply interconnected that it is not easy to determine which precedes the other. The dependency of time on movement also underscores its connection with the materiality of the universe, as movement always involves a mover and cannot be conceived without matter. Therefore, time is also related to matter (Madelin, 2016).

Movement is an inherent characteristic of a body and a result of matter itself. A body cannot exist without motion. Each body has both translational and rotational movements, as well as other types of motion. The observable and measurable movements are external, while the intrinsic movement of a body cannot be understood through mere observation and sensory experience. This intrinsic movement is essential to the body; if it lacks such movements, it cannot be considered as existing. The assertion that a body cannot exist without motion also clarifies the fact that movement does not happen without a mover (Ebrahimi-Dinani, 2013).

In other words, movement is intrinsic to the body, and the various states of the body correspond with different moments in time. Ibn Sina and Mulla Sadra believe that movement signifies a change occurring in an object, essentially something that has emerged which was not present before. These transformations occurring within an object are considered types of motion, suggesting that "an object appears to be at rest yet is in fact in motion" (Motahari, 1987: 26). The Quran also refers to movement, highlighting that even mountain, which appear solid and stationary, are in motion and flowing like clouds by God's creation (Quran, 384).

Time measures and counts the existence of objects due to its connective identity. Mulla Sadra introduced time as an analytical characteristic of objects, asserting that the essence of objects is contingent upon their temporally significant movement. Thus, he regards time as a dimension of matter, yet this dimension, unlike the other dimensions, is transient and gradual (Sadr al-Din Shirazi, 1998: 69, 71). Ibn Sina also considers time as a measure of movement, and he sees movement as dependent on the mover. He maintains that the inseparability of the mover from matter is evident, and when Ibn Sina characterizes time as a measure of movement, he emphasizes the realistic aspect of time (Ebrahimi-Dinani, 2013: 89).

The world is in a constant state of change and transformation due to movement, and time is regarded as the measure of this movement and change (Russell, 2015: 499). According to Heidegger, movement refers to the transformation or transition from one state to another, which is not necessarily spatial. This implies that during this transformation, it is not required to witness spatial change of the body (Heidegger, 2016: 302).

Consequently, the materials used in the artworks we encounter in conservation and restoration are continuously intertwined with time, and the artworks are intrinsically temporal due to their material structure, allowing for organized and continuous atomic movement. Time is inherently linked to movement. Based on the principles of the intrinsic temporality of the material of the artwork, specific changes in the material can be taken as criteria for estimating the precise age of monuments through instrumental methods and accurate measurement in various experiments. This plays a crucial role in determining the period of the work in technical studies of conservation and restoration.

This element is critical in the field of time measurement; in studies of dating, we face not only macroscopic scales but also microscopic scales, where changes within the body can be measured and analyzed temporally through precise instrumentation. Although the effects of these movements within the material may also manifest visibly to humans, such as the annual growth rings in cross-sections of tree trunks, each indicating the passage of a year due to changes in the material during different seasons of growth.

based on the science of chemistry-physics, it has been established that even in seemingly stationary objects, continuous movement and dynamism are occurring within the substance and atomic structure. Movement is specifically dependent on time, and the nature of time is movement. With the help of the perception of temporality, humans can understand the changes that have been created by movement and quantify them numerically. Every object is formed through movements, and these movements require the passage of time to take shape and be completed; in other words, the characteristic of movement is that it is time-consuming and requires the passage of time (Carli, 2017).

If change is not inherent in a being, it will necessarily require a cause, which creates a cycle of causation that is invalid. In fact, a thing requires a cause to exist, but in motion, "the motion is inherent to the thing and is related to its existence; thus, if a thing exists, it is in motion" (Ebrahimi-Dinani, 2013: 577). In this regard, a statement by Mulla Sadra is discussed, which states that time requires a motion to sustain it. Rest cannot be found except in time, and the sustainer of time is a cyclical motion; time, due to its connective identity, possesses quantitative movements, and the number, amount, and connective identity of time are the same. Especially cyclical movements, by which other movements are measured, but the cause of time itself is outside the chain of time and space (Sadr al-Din Shirazi, 1998).

In fact, thinkers have related time to the amount of movement, and if there is a movement, its existence will be in time. According to Plato, who presented the first ideas about time, time is associated with ordinary physical events such as the movement of celestial bodies that have specific orbits for organized and infinite cyclical motion, and these regular movements are commonly suitable tools for measuring time, which humans use to measure a day (Weinert, 2013).

Movement is time-bound, and time is recognized through movement (Young, 2004). Movement is associated with change, and in the timing of works, changes in the material of the works are often tracked in the form of observable phenomena. Change over time is what makes it possible, and this is a sign of the existence of objective time. Movement, in another sense, makes time comprehensible in nature for humans. Movement causes change and our experience of sensing time. If a work is created, there is a time for its manifestation, and time has been spent on its creation and completion to come into existence from raw material.

In other words, it can be said: "The special characteristic of movement is that it is time-consuming and requires time for completion" (Carli, 2017: 45-63). As previously mentioned, timing methods based on the changes that occur in the substance due to movement at the molecular scale can measure and demonstrate time with their special tools, and the following will discuss the ways of manifesting objective time in works.

Time and Processes of Erosion

The world is in a constant state of change and transformation; for nature, change is a proven fact, and time arises from these transformations and their organized movements. In this perspective, time measures movement and represents its quantity. As previously mentioned, Aristotle is a prominent advocate of this thought. Change is a real phenomenon, and in this viewpoint, time is an objective phenomenon that can be measured in time units (Sadr al-Din Shirazi, 2013: 140; Bardon, 2016: 15-23). The concept of time that arises from the phenomenon of movement is the first concept of time, which is more related to scientific studies in the realm

of movement and belongs to the field of physics. The relationship between time and movement is essentially the measurement of movement by means of time (Heidegger, 2008: 77- 76). The passage of time, or the occurrence of events, is irreversible and unique. Change and transformation are significantly dependent on time. The spatial coordinates of objects are functions of the variable time. For every passing second (t), we can present three spatial measurements: (x, y, z). These coordinates can pertain to any point whose values are functions of time. Thus, whenever time changes by a very small amount, the values of the spatial coordinates also change (Ibid, 78). This change, in the form of movement, applies to all points of the object and occurs even in its seemingly stationary core. According to Mulla Sadra, the different states of an object correspond to different instances of time. He, as well as Avicenna, believe that the changes that occur in an object are of the nature of movement, and time is dependent on movement, and an object that appears to be at rest also inherently possesses movement. Movement has two dimensions: time and distance, and rest occurs in the dimension of time (Motahari, 1987: 26).

Mulla Sadra did not view movement and time solely as external to objects, but rather considered the essence of objects to be temporal. If this were not the case, it would not be possible to measure them with time or determine the age of an object—just as if objects lack length or weight, they cannot be measured with scales of length and weight. On the other hand, time is a measure of movement, so it is essential that the essence of objects possesses movement. This is why, over the passage of time, changes and transformations occur in an object, and these changes are not only superficial but also happen within the core of the object due to the existence of movement, transforming it. An object is inherently in motion and is temporal (Sadr al-Din Shirazi, 1998: 69-71).

According to various chemical-physical discussions, we know that within the substance of objects, there is a continuous movement of atoms around themselves and around the nucleus, occurring systematically and to scale in atomic and molecular orbitals. These movements are inherent to all states of matter, flowing within the material structure of the universe, and are a product of matter: "The origin of movement is the same as the origin of primordial matter." A material body cannot exist without movement (Ebrahimi-Dinani, 2014: 342). The movement of molecules and the occurrence of various chemical reactions in response to environmental conditions predispose each object to change, transformation, and perishability. Thus, all objects, including human-made artistic works, are susceptible to wear and destruction, for "the eternal existence of an object is impossible" (Sadr al-Din Shirazi, 2013: 191). Despite knowing the perishability of works, conservation and restoration are undertaken due to their uniqueness and human dignity as material culture or time-bound substance, effectively preserving the past as a truth in the present.

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To express it in the words of Henri Bergson, a contemporary philosopher, the material world exists as a moving continuum, where everything changes and leaves remnants behind. The ever-changing existence in the present represents the truth of the object (Fell, 2012: 34-40). Change is made possible by the passage of time and can create an objective understanding of the passage of time. The objective existence of time's passage means that infinite layers of "now" are generated sequentially (Kennedy, 2014: 61).

Movement in the form of change is typically seen as layers of erosion on the surface of an object. These layers often appear on the surface with a different appearance and color from the object itself, representing the passage of time and the accumulation of layers of the present, caused by the interaction of the material of the object with surrounding conditions. Because nothing in the world is destroyed by itself; rather, it deteriorates and perishes due to something other than itself (Ebrahimi-Dinani, 2014: 357).

In regard to historical and cultural monuments, various environmental conditions, especially the presence of moisture in burial environments or proximity to light and electromagnetic waves, air pollutants, and sometimes in urban environments, the presence of contaminants and dust particles significantly influence the initiation of chemical, photochemical, and biochemical reactions, causing changes in the material of the monument and its transformation. All these transformative chemical processes occur in the framework of movement in the molecular structure, so that as a result of these chemical interactions, sometimes the material over the years transforms into another substance. This change represents the passage of time and the age of the monument or, through a phenomenological perspective, appears as the manifestation of time in human awareness in the form of eroded layers. Consequently, the layers of wear on the monument must be protected as manifestations of time and the sequential "nows" of the past (Yousefnejad, 2021).

Change is a law of nature, and the efforts to protect, reduce it, and preserve the past exist in the present. In the current moment, change is inevitable; therefore, the goal of conservation and restoration, despite the knowledge that an object is inherently in constant transformation and, like everything else in the material world, is subject to decay, is to protect the essence of the monument. This is pursued because preservation cannot stop change and transformation in the monument; otherwise, it would merely subject the monument to endless cycles of extensive treatment, which could pose a threat to the monument's integrity (Edgren, 2016).

Thus, when confronting objects in the realm of conservation and restoration, the material used in the monument is continuously linked to time, and the monument is inherently temporal due to its material structure. Within this material, there is a structured and ongoing movement at the atomic level, and time, from the perspective of realist theories that regard it as objective, is intrinsically related to movement.

With an objective view of time based on the principles of the inherent temporality of the monument's material, specific changes in the material of the monument can be used as standards in evaluation methods in scientific conservation and restoration studies. By measuring this change over a defined period using instrumental methods and precise tools in various experiments, the age of the monuments can be accurately estimated. This plays a significant role in determining the time period of the monument in the context of technical studies in conservation and restoration (Liritzis et al., 2013). As the composition of a monument changes over time, its age can be calculated with precision or relatively, depending on the selected methods (Caple, 2006).

Radiocarbon Dating

During the 1940s to 1950s, the discovery of chronometry using carbon-14 made it possible to date remnants of living organisms. Carbon-14 is a radioactive isotope (heavy isotope) of the stable element carbon, which converts to nitrogen-14 through beta-minus decay. The production of carbon-14 occurs at altitudes of 6 to 15 kilometers in the Earth's atmosphere, where high-energy neutrons are generated by cosmic ray collisions with the Earth's atmosphere, which then collide with nitrogen atoms to create carbon-14.

Once formed, carbon-14 atoms quickly combine with oxygen, leading to the formation of carbon dioxide-14 (CO_2-14), which is released into the atmosphere and enters the global carbon reservoir on Earth through three sources: interaction with surface ocean waters and transfer to deeper waters, incorporation into plants through photosynthesis, and ultimately entering the bodies of animals and humans through food chains. It has been shown that the production of carbon-14 in the atmosphere is in equilibrium with its radioactive decay. As a result, the total carbon-14 reservoir on Earth remains constant.

When a living organism dies, the atoms of its organic matter exit the natural nutrient cycle (including both nutrient intake and waste). Consequently, the carbon-14 stored in the dead organism is now separate from the total global radioactive isotope reserve, and over time, it undergoes decay with a half-life of approximately 5730 years, gradually decreasing in quantity. This change in the amount of carbon-14 present in historical monuments, compared to today's constant levels, indicates how long it has been since the organism in question died (Holdaway, 2014: 86-89).

Thermoluminescence Chronometry

The thermoluminescence method is used for dating ceramics, pottery, and bricks. Thermoluminescence has the capability to emit light when the sample is heated to specific temperatures. The thermoluminescent light emitted from pottery indicates the release of energy stored in the minerals present in the clay; this energy is transferred to the body from two sources:

Radioactive materials, found in the clay or its surrounding environment, such as uranium, thorium, potassium, or rubidium. Ordinary clay is a mixture of various minerals and organic materials and contains a certain number of radioactive materials relative to its constituent substances. These radioactive materials emit alpha, beta, and gamma rays with specific energies during their decay. The energy released from these radioactive materials is stored in solid crystals, such as quartz and feldspar, found in the clay.

Cosmic rays. The majority of these rays consist of high-energy protons with deep penetration capabilities. The energy from the ionizing rays present in the clay and cosmic rays has been stored since the minerals were formed. This energy can remain in the material for up to approximately 10 million years. However, when the material is heated, this energy is released all at once. During the firing of pottery in a kiln, all of this energy is released; it can be said that the thermoluminescence clock for baked objects resets to zero. After the pottery cools, the process of storing energy from ionizing rays begins anew, and the thermoluminescence clock starts functioning again.

The amount of energy stored in the pottery is proportional to the time elapsed since its firing in the kiln, which is the fundamental principle of thermoluminescence dating. If the sample is subsequently heated in the laboratory, the amount of energy stored can be measured over time, and by estimating the amount of energy transferred to the material annually, the age can be determined (Bahr al-Olumi, 2012). In this method, as previously mentioned, the basis for measuring time is related to the movement of electrons due to the absorption of energy and their transition to a higher energy level, followed by a return due to the emission of energy to a lower energy level. The elevation of an electron to a higher energy level occurs due to the heating in the laboratory, and the measurement of the emitted rays is used for dating purposes.

Dendrochronology

Dendrochronology is used to determine the age of wooden artifacts. In this method, the age is determined based on the annual growth rings in trees. Therefore, in dendrochronology, the relationship between time and the movement and change in matter is utilized, where the change occurs due to the growth process and the formation of annual rings in the tree, serving as an objective phenomenon for measuring time. The growth and formation of secondary wood are marked by the formation of rings that are distinct from previous rings each year. By examining the growth pattern and thickness of each ring, one can infer the climatic conditions and the suitability or unsuitability of the environment for plant nutrition, and additionally, by counting the number of secondary rings, the absolute age of the tree can be determined.

Thus, standard conditions have been established for the annual growth and development of each type of tree in past years. By placing the growth conditions of each type of tree into a

standardized table presented diagrammatically, one can find the lifespan of the tree and consequently its absolute age. This method can determine ages of up to six thousand years. By using the growth rings of specific species as a model and determining their age by counting the growth rings, one can compare unknown samples of wood from historical monuments to ascertain the age of the monument (Holdaway, 2014: 91).

Conclusion

Time is a phenomenon with various aspects that, for its understanding as the principle of the existence of objects, is examined based on the implementation of phenomenological strategies regarding its emergence and manifestation in human consciousness for identification in scientific studies of conservation and restoration. Its objective nature is analyzed in monuments. Time, in its objective aspect, is defined and measured by movement and change, and in this aspect, it is a measure of movement. Thus, there is a profound and meaningful connection between movement in various dimensions of matter and the phenomenon of time. Movement within matter, through various interactions, causes changes and transformations, which serve as the basis for determining the age of different monuments and can be assessed and measured through various dating methods.

Common instrumental methods for determining the age of monuments are based on measuring the changes that occur within their material structure and analyzing them, effectively assessing and manifesting objective time within them. This is because objective time, due to its close relationship with movement, change, and transformation, is dependent on the material of the monument and can be determined and measured through specific scientific methods.

The changes and transformations occurring in monuments are due to various reactions within their material structure. During these reactions, movement occurs at the molecular scale, resulting in the manifestation of layers formed from the products of these reactions on the surface of the monuments. In fact, the processes of erosion of monuments indicate changes within the material of the monument, and the changes in matter themselves reflect the molecular movements and exchanges occurring within the objects. Therefore, studying and identifying the processes of erosion of monuments and scientifically analyzing them to determine the altered layers indicate the time elapsed on the monument. Since time is the principle of the existence of the monument, preserving and maintaining these layers under stabilized conditions is essential for the conservation of the monument's existence. Studies identifying the processes of erosion and determining the altered layers can also identify potential damages, and since not every change is damage, these studies are of great importance in the preservation and maintenance of monuments.

Author Contributions

All authors contributed equally to the conceptualization of the article and writing of the original and subsequent drafts.

Data Availability Statement

Not applicable

Acknowledgements

The authors would like to thank all participants of the present study.

Ethical considerations

The study was approved by the Ethics Committee of the Islamic Azad University, Central Tehran Branch. The authors avoided data fabrication, falsification, plagiarism, and misconduct.

Conflict of interest

The authors declare no conflict of interest.

References

Aristotle. (2014). *Sama-e Tabiei* (Physics), volume 2, (Lotfi, M. H. Trans.). Taha Nu Publications, Tehran.

Bardon, A. (2016). *History of the Philosophy of Time* (Amiri Ara, H. Trans.). Korgden Publications, Tehran.

Bahr al-Uloomi, F. (2012). *Dating methods in archeology*. Samt Publications, Tehran.

Caple, C. (2006). *Objects: reluctant witnesses to the past*. Rutledge, New York.

Carli, S. (2017). Energia and being in Time. *The review of metaphysics, 7*(1), 45-63.

Cresswell, J. W. (2005). *Educational Research: Planning, Conducting, and Evaluating quantitative and qualitative research*. University of Nebraska, Lincoln.

Campbell, J. (1997). The Structure of Time in Autobiographical Memory. *European Journal of Philosophy, 5*(2), 105–118.

Davidson, M. (2004). Four Dimentionalism. *Analytical philosophy, 45*(1), 17-33.

Edgren, L. (2016). Contemporary Conservation Theory for Sustainable Development of Cultural heritage Objects. *The international journal of inclusive museum, 10*(1), 8-18.

Ebrahimi Dinani, Gh. (2013). *The Enigma of Time and the Creation of the World*. Iran's Hikmat and Philosophy Research Institute, Tehran.

Ebrahimi Dinani, Gh. (2014). *From Sensible to Reasonable*. Research Institute of Hikmat and Philosophy of Iran, Tehran.

Fell, E. (2012). *Duration Temporality, Self: Prospects for the Future of Bergsonism*. International academic publishers, Oxford, Peter Lang, Switzerland.

Glendinning, S. (2008). What is Phenomenology? *Philosophy compass, 3*(1), 30-50.

Heidegger, M. (2008). *The concept of time* (Naqshband, N., & Ranjbar, M. Trans.). Parsesh Publications, Abadan.

Heidegger, M. (2016). *Being and Time* (Rashidian, A. K. Trans.). Ney Publishing, Tehran.

Holdaway, S. (2014). *Archaeology in Practice: A Student Guide to Archaeological Analysis*, edited by Jane Balme, and Alistair Paterson, John Wiley & Sons, Incorporated, ProQuest eBook Central, http://ebookcentral.proquest.com/lib/tehranart ebooks/detail.action?docID=1597993.

Horel, C. (1998). The Perception of Time and the Notion of a Point of View. *European Journal of Philosophy, 6*(2), 156–171.

Kennedy, J. B. (2014). *Time and Einstein, An Introduction*. Routledge, New York.

Levinas, E. (2013). *From Existence to Existence* (Alia, M. Trans.). Phoenix Publishing, Tehran.

Le Poidevin, R. (2015). *The Experience and Perception of Time*. In Stanford Encyclopedia of Philosophy. https://plato.stanford.edu/entries/time-experience,7/16/2018.

Liritzis, I., Singhvi, A. K., Feathers, J. K., Wagner, G. A., Kadereit, A., Zacharias, N., & Li, S. H. (2013). *Luminescence Dating in Archaeology, Anthropology, and Geoarchaeology An Overview*. Heidelberg: Springer.

Madelin, T. (2016). *Philosophy of Physics* (Salimi, R. Trans.). Phoenix Publishing House, Tehran.

Motahari, M. (1987). *Motion and Time*. Lessons of Asfar, Volume 2, Hekmat Publications, Tehran.

Plato. (2009). *Timaeus*. Volume 3, (Lotfi, M. H. Trans.). Khwarazmi Publications, Tehran.

Sadr al-Din Shirazi, M. I. (2013). *Asfararbea, Safarol* (Khajawi, M. Trans.). Molly Publications, Tehran.

Sadr al-Din Shirazi, M. I. (1998). *Al-Haduth al-Alam treatise, Creation of the World* (Khajawi, M. Trans.). Molly Publications, Tehran.

Smart, J. J. C. (1968). *Problems of space and time*. The Macmillan Company, New York.

Spiegelberg, H., & Schumann, K. (2013). *Phenomenological Movement, Historical Income* (Alia, M. Trans.). Minoy Khord Publications, Tehran.

Torrance, H. (2008). Building confidence in qualitative research. *Qualitative inquiry, 14*(4), 507-527.

Russell, B. (1961). *Einstein's Concept of Relativity and its Philosophical Results* (Taluai, M. Trans.). Amir Kabir Printing and Publishing Institute, Tehran.

Russell, B. (2015). *History of Western Philosophy*, Volume 1, (Daryabandari, N. Trans.). Parvaz Publishing House, Tehran.

Wall, J. (2015). *Debate in the Aftermath of Nature* (Mahdavi, Y. Trans.). Khwarazmi Publications, Tehran.

Weinert, F. (2013). *The March of Time*. Springer, London.

Young, J. (2004). *Art and knowledge*. Published in the Taylor & Francis e-Library Rutledge, London.

Yousefnejad, S. (2021). *Theory of Time and Conservation & Restoration*. Jahad daneshgahi, Tehran.

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Structure and Meaning in the Design of Various Types of Furniture Engraved on Silver Dishes of the Sassanid Period

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Article Info	ABSTRACT
	Based on the obtained visual evidence, the use of sofas and chairs in the ancient governments of Iran had a special design, role and importance in any period, and their practical and semantic importance can be examined from different works of art. This research aimed to identify the visual structure of the types of furniture engraved on the Sassanid period silverware and investigate the meaning and effects of the engraved designs on the furniture in order to represent the specific visual aesthetic point of view of that era. The research method of this article is fundamental in terms of its nature and descriptive-analytical in terms of its method, and the image data were selected based on the designs and shapes of the furniture engraved on the Sassanid period silverware. The results indicate that the court furniture in this period is depicted in three forms: bed or couch, mat and back, and bed and mat in the plates. and it was meant to instill the power and dignity of the king and they were executed in accordance with the occasions of war and battle and it was found that the meanings of the mentioned motifs were more important than their historical or narrative concepts. It was a sign of the power and importance of the king and the courtiers, and it was one of the means of propagandizing and spreading the Sassanid culture.

Introduction

Archeological records and documents left from ancient cultures in various lands show that the chair as a means of sitting has existed in different forms since thousands of years ago. Most of the furniture has a functional or decorative aspect in the place where people live, and furniture as it is today did not exist in the old Iranian culture. However, Herodotus believes that the ancient Iranians eat and sleep at the table, although Herodotus' reports of Iranian customs and traditions, according to his life history (425-484 B.C.), are comparable to the two Achaemenid kings Khashayar Shah and Ardeshir I. The method he used for his historiography is a narrative method and it is possible that what he wrote was transmitted to him by the narrator. But according to historical documents, in the period when Iranians sat on carpets and Iranian homes were very simple; Usually, a zilo or felt was spread on the floor and one or more mats, along with pillows for sitting or sleeping on it, and short tables or stools for placing dishes, were installed in the rooms. This type of furniture was the arrangement of the normal lifestyle in ancient Iran. However, according to the images engraved on the works of art of ancient Iran, especially in the Achaemenid and Sassanid eras, the preparation of suitable furniture, beds and footstools was considered one of the requirements of court life. Of course, examining the evolution of the ways and customs of sitting and leaning on the chair on the throne and the court for kings has an ancient history alone that requires a separate topic. However, in this article, the visual structure of the design and the role and cultural meanings of the types of furniture engraved on the Sassanid period silverware and their location are examined.

Research Method

This research is fundamental in nature and descriptive and analytical in terms of its method, and materials and images have been collected and analyzed from reliable library sources and internet sites. Also, appropriate drawing programs have been used to analyze the designs. The statistical population of this research includes all Sassanid period silver vessels that were used from the beginning to the end of the kingdom of this period and includes motifs related to various types of furniture, and in this article, about twelve selected samples are examined.

Research Background

During the investigations carried out on the history of furniture in ancient Iran, only short references have been observed in some books. In the book "Survey of Iranian Art, from Prehistory to Today" by Arthur Upham Pope, in the sixth volume of the seventh section, there is a brief reference to household furniture, beds, and sofas (Pope and Ackerman, 2008). Mohammad Reza Namdari, in the book "Style and History of Furniture" (2015), in the first volume, has mentioned the styles of furniture in ancient Iran in a short text. In the book "Art of Iran during the Parthian and Sasanian eras" written by Roman Girshman (1992), motifs and symbols used in

Sasanian silver dishes and plates are introduced. Also, in the book "The Influence of Sassanid Art on Islamic Art" written by Abbas Zamani (2013), various arts, including the art of metalwork and Sassanid plates, were introduced and analyzed, and its influence on Islamic arts was stated. High-quality images of works and visual proofs of furniture designs are also available on reputable websites, such as the sites of the "Victoria and Albert" and "Cleveland" museums and other museums in the world.

Throne and Court in Ancient Iran

According to the existing written and pictorial sources, a chair has been used as a means of sitting since several thousand years ago in various lands and civilizations of the Middle East and West Asia. One of the prototypes of a chair is a simple stool for sitting. The available documents show that the oldest four foundations in the ancient Iran area are related to the archaeological excavations of "Tepe Cheshme Ali 1". This stool belongs to the second half of the 6th millennium BC, it is made with a mixture of clay and straw, and its cover is red (Figure 1).
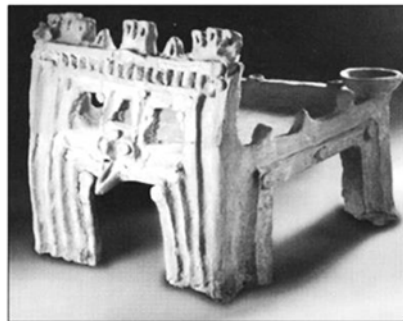
Figure 1. A clay tripod, belonging to the second half of the sixth millennium BC. National Museum of Ancient Iran (Source: Esfandiari, 1998)

Also, many examples of the structure of furniture, which is a proof of the use of chairs and beds in Elam civilization, can be seen on the patterns of cylindrical seals left from this era. For example, a piece of bituminous plaque, which is considered one of the most beautiful works of art in New Elam, is known as the Spinning Lady. This tablet made of bitumen paste is 13 cm long and 3.9 cm wide. The mentioned tablet shows the image of a woman holding a spinning wheel and sitting on a chair or a four-legged stool in the oriental style, which has legs in the shape of a lion's paw. In front of the spinner lady, there is a stool with legs in the shape of a lion's paw, on which there is a container containing a fish with six round fruits (Figure 2) (Ameh, 2011: 112).

Figure 2. Piece of bituminous plaque made of bituminous paste, 13 cm long and 3.9 cm in Elam period.

In the Achaemenid period, furniture with only a little more detailing than in the Elam period can be seen in works of art, which is perhaps considered one of the best examples of furniture, beds and chairs in ancient Iran. Unfortunately, the originals of these works have not been found in archaeological excavations. However, examples of thrones and chairs are carved and visible on the prominent reliefs of Persepolis, such as the public scene of Darius in the Treasury of Persepolis, the scene of King Xerxes sitting on the royal throne, or the motifs above the tomb of Darius in Rostam Naqsh. In one example, Darius is sitting on the throne and the representatives of 28 nations are holding the said throne on their heads. Behind him stands the crown prince of Xerxes. On top of the bed there is a cover that has many ornaments" (Girshman, 1992: 199). According to Roman Girshman, the furniture in the Achaemenid period is mostly in the form of chairs, which have bases of animal symbols such as lions and eagles (Girshman, 1992: 382) (Figure 3).

Figure 3. Dariush's public scene. Achaemenid period. Throne of Jamshid. (www.parsiandej.ir).

After the Achaemenians, Parthian art is of particular importance due to its great influence on the formation of Sassanid art and depiction of the Islamic period. The Parthians were able to rule the land of Iran for more than five centuries. The silver and bronze coins of the Parthian kings are considered to be the most important documents of Iranian history, culture and artistic masterpieces. On the back of most of the coins, the images of the Parthian kings sitting on chairs are beautifully engraved (Figure 4) (Shakuri Far and Nasrollahzadeh, 2015).

Figure 4. Farhad II Parthian coin, the queen sitting on a chair. (www.tamadonema.ir)

But in the Sassanid period, Iranian civilization reached its maximum prosperity and prosperity in terms of artistic achievements. As a result of trade relations and continuous wars between Iranians and Romans, Roman art penetrated Iran, and these influences are clearly visible in Sasanian metalwork art, such as the images of dancing women engraved on Sasanian silver vessels (Figure. 5). In this period, the mass production of metal objects, along with other arts, led to the expansion of trade and, as a result, economic progress. The art of metalworking was a courtly art, and next to the royal palaces, there were workshops for making these precious and luxurious objects. In these workshops, silver was used to make various dishes and gold was used to gild them. Folk art has also been influenced by court art, and in cases where it was not possible to use gold and silver metals to make dishes, artists used low-cost alloys and created beautiful works by following the same luxurious method (Pope and Ackerman, 2008: 180).

The art of metalwork in the Sassanid period

In the Sassanid period, advanced techniques were used to make Zarandod silver dishes. The technique of two shells, welding a piece of gold on the surface of silver, drawing a thin shell of silver on the prominent parts of the container, and using casting are among these techniques. During this period, bronze alloy was also used a lot to make various objects, such as war weapons, small statues and kashuk-shaped containers. At the end of the Sassanid period, the use of silverware to make dishes received more attention, because the color of silverware is as transparent as gold and silver, and those classes who could not use silver, replaced it with vessels made of silverware. (Figure 5 and 6).

Figure 5. Teng with patterns of musicians and dancers, silver Hermitage Museum (Moslehi, 2018: 83)

Figure 6. Silver plate with the image of an eagle holding a woman in its claws, Freire Museum (Fariyeh, 1995: 348)

But the most important metal works that have remained from the Sassanid period are silver vessels, some of which are gold-plated. According to the observations of the works in the museums, some of these silver containers have different shapes, the most common of which are: tights, hemispherical bowls, rhytons and plates. Tangs are very diverse in terms of shape and most of them are decorated. For example, tights with a pear-shaped body, an opening with a beak-like spout, a long handle with a decoration on the top of the handle, a long circular or funnel-shaped base. Also, tights without handle and base, the mouth of which is simple and without a drain, and various motifs are drawn on them, such as mixed animals, dancing women, and traditional motifs in the Sassanid period. Also, Sasanian metal bowls with various motifs such as musicians and dancers along with symbolic motifs inspired by Roman art have been common. Rhyton or Tekuk were also glass-like containers that were used to drink liquids and were made in the shape of animals or composite creatures. Making such dishes was popular since the pre-Sasanian era. Plates with short walls are one of the most abundant examples of Sassanid metalwork art and are often decorated with various images such as the hunting of kings, the king and queen sitting on the throne with attendants and mixed animals. The background of the plates is also engraved with ivy, hair leaves, pomegranate bush, birds and common symbols in Sasanian art.

It is necessary to explain that "due to the wars that happened between Khosrow II and Heraclius, the Roman emperor, and also after the Arabs entered Iran, a large number of silver and gold objects were looted or melted down to make coins. For this reason, the number of silver objects obtained from the Sassanid period is very limited. Most of the silver vessels of this period have been discovered outside the current borders of Iran, and for various reasons, the correct date and origin of those found in Iran is not known (Pope and Ackerman, 2008: 182).

The use and types of furniture in the Sassanid court

Iranians in the Sassanid period often preferred to sit on all fours on the ground, but in the surviving images of Sassanid art, courtiers often sit or lie on a bed decorated with backs of patterned fabrics. This method of sitting has been common throughout the Near East for several centuries. Also, for more comfort, mats were placed on the floor and flat mats were stacked on

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one side to lean on. In other examples, there is a short chair on which a mattress and a pillow are installed. In examining the structure of furniture in the documents left over from the art of the Sassanid era, the use of beds and courts decorated with symbols and beautiful motifs can be seen. The construction of the beds in this period is mostly flat and rectangular with thick bases and an hourglass appearance. Also, in one sample, their middle part is decorated in the form of a vase, and on another bed there are two khorjins and decorative "friezes". The court figures are sitting and leaning on these couches in such a way that they convey the impression of a comfortable lick to the viewer.

The structure of the furniture in this period is the continuation of the Parthian style of Roman origin, but the idea of placing the royal throne on top of animals, which were the symbols of the king in any case, is left over from the ancient East. Examples of this style can also be seen in the Sumerian and Achaemenid kingdoms. Apart from this, the shape of the supporting pillars of the eastern Sassanid thrones are mostly in the form of imaginary animals, lions and winged horses, all of which are seen as symbolic motifs in most Sassanid period arts (Durant, 2011: 330).

Descriptive analysis of types of design and role of furniture

On an example of a gold-plated ceramic plate, there is a scene of royal revelry and joy, the king is sitting on a mat with patterned backs and drinking, and in front of him is the queen sitting on the mat, talking to him. Behind the king, a man is standing respectfully and a group of musicians are playing music, one of them is playing an instrument and produces sound with his mouth, and another musician is playing a stringed instrument. At the bottom of the plate, a stove is lit and cooking food, and a tree with a bird sitting on its branch fills more than half of the edge of the plate (Mohammad Panah, 2006: 190). The king and queen are slightly larger than the others and are drawn in the center of the image to emphasize their dignity and position (Figure 7).
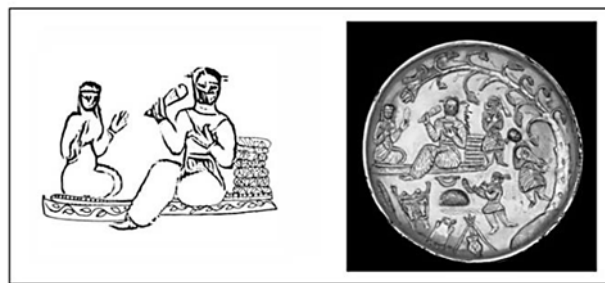
Figure 7. Sasanian silver plate. 7th century AD. Qatar 19.7 AD Leningrad Museum (Source: www.tamadonema.ir; Sketch: author).

On another cement vessel, Bahram Gur, one of the prominent Sassanid kings, is seen presenting a "royal ring" to a woman, a sign of royalty and a symbol of Yazidi fur. The woman wears a crown with ram's horns, among the horns of the crown is a pomegranate, which shows

her connection with the goddess of fertility with the flower pattern carved on the woman's dress. Bahram and the queen are sitting on the throne, on one side of the throne there are pillows with plant and geometric motifs, this throne is the seat of the king, which was also called royal orang. The legs of the bed are in the shape of an hourglass. The presence of three heads of pigs at the bottom of the Majlis is related to Nowruz celebration, where it was customary to present offerings (Kristen, 2003: 86) .The placement of the king's head and hand while offering an offering to the queen; It is an imitation of the Sasanian reliefs with the theme of presenting the royal ring by Ahura Mazda to the king in the Sasanian period, which both shows the king in the position of Ahura Mazda and gives credibility and sanctity to this assembly (Figure 8).

Figure 8. Sasanian silver plate. Bahram and the queen on the throne. 6th and 7th centuries AD. Diameter: 23.3 cm. Baltimore Art Gallery. (Kristen, 2003).

In the center of another gold-plated silver plate, a royal banquet is depicted. In this scene, the king, leaning on the carved backs, bestows the Shahriari symbol on the queen. The legs of the bed are narrowed like an hourglass in the center and decorated with a golden clasp. A ram's head can be seen under the bed. In Zoroastrian texts, the ram is associated with royal glory, and the ram's head, which is designed in most of the works, is a symbol of the heroic aspect of the royal banquet (Hall, 2004: 136). In this plate, in terms of structure, composition and meaning, the act of bestowing the Shahriari symbol on behalf of the king to the queen, like the reliefs of the dedication of the royal ring, has a sacred aspect (Figure 9).

Figure 9. Sassanid silver plate, diameter 19 cm. Location: Smithsonian Museum (Source: www.tamadonema.ir; Sketch: the author)

In the decoration of the inner part of another Zarandod silver plate, the compatibility and cultural influence between the eastern Mediterranean regions and Iran can be seen. In the center of the picture Dionysus, the Greek god, is shown in a female form and the smaller figure sitting behind the god is the princess Ariadne. On his right, Hercules is seen standing. Under the throne are two angels, on both sides of a circle that symbolizes the sun. This bed was probably mobile and was used to carry the queen. The image carved on the vessel shows the scene of the triumphal entry of Dionysus, which was a popular theme in Roman art and was transferred to Sasanian art (Holmes, 1969: 224). This plate belongs to the late Sassanid period because the female figure has a material and earthly aspect, like the mosaic works of Bishapur Palace in Fars province; Although it represents Greek mythology and the presence of Roman angels also shows the influence of Roman art on Sasanian art. The sitting style of Dionysus and the three-faced facial expression in this plate and other works from the late Sassanid period had an effect on the painting art of Iran after Islam (Figure 10).

Figure 10. Silver dish, Sasanian period, 7th century AD. Diameter 21 cm. Smithsonian Museum (Source: Holmes. 1969; sketch: the author)

Another silver plate from the Sasanian period, in the Hermitage Museum, shows the king seated on a throne, with musicians playing wind, percussion and stringed instruments (harp), and a singer singing with his hand under his ear. Behind the king, someone is standing with his hands on his chest in a respectful manner. An angel on top of the stage is sealing the atmosphere, and the symbols of flowers and hearts are carved on the background. The king stretches his legs on the bed and rests on three pillows with the same flower motifs and is smelling a lotus flower branch with a cup in his hand. The mat on the bed is engraved with plant motifs and grapes. The presence of the king in the center of the plate shows the importance and authority of the king while accompanying the people in the Bazam ritual (Figure 11).

Figure 11. Sassanid silver plate, 6th century AD. Qatar, 16.2 cm. Armitage Museum (Source: www.kherada.com; Sketch: the author)

Inside the silver plate, the king with a crown in the form of ram's horns is seated on a throne in the center of the royal hunting scene and, turning his head, looks at the scene of the deer being hunted by the lion. Another deer is lying at the bottom of the bed. The ground of the dish is carved with vegetation and a flowing stream. The king wears a long dress over loose trousers. The king is leaning on a pillow on a throne decorated with a mattress of repeating geometric patterns, behind him is a person standing on the throne fanning him. The bed has two legs, as if the other leg was removed due to the limitation of the drawing space, but the placement of the bed is maintained. Unlike the previous examples, the bed bases are curved towards the outside of the bed (Mohammad Panah, 2006: 184).

The crown of Shapur I with a toothed ring as a sign of royalty and as a sign of the layers of heaven and heaven is on the king's head, in the golden point of the plate. The king's licking on the back and his sitting on the mat while the flycatcher is standing behind him is an emphasis on the king's dignity and power (Figure 12).

Figure 12. Sasanian silver plate, Shapur I Bartakht. 7th century Diameter 23.2 cm. The Armitage Museum. (Source: Mohammed Panah, 2006; Sketch: author)

On another silver plate with a gilded background, the king is depicted as the main figure, larger than the others, on a short throne, leaning on three backs while crossing one leg over the

other. The legs of the bed are in the shape of a winged horse. A winged horse is a sign of magical connection and a sign of nobility, magnanimity and chivalry. The edges of the bed are also spiral.

This scene shows a Sasanian-style party and an example of oriental narration. Like other Sassanid kings, the king wears a crown on his head and a cup, which is a symbol of power. Musicians are playing with different musical instruments and an angel is flying over the stage giving blessings, which shows the influence of Roman art on Sasanian art (Figure 13).

Figure 13. Gold-plated silver plate. King Bartakht. Diameter 24 cm. 8th century AD. Smithsonian Museum (Source: www.ariai.com; Sketch: author)

In another Sassanid silver tray, Khosrow Anushirvan is shown with four nobles in a state of respect. At the bottom of the dish, the scene of hunting rams is carved by his son Hormuz IV (Holmes, 1969: 229) .The king with a sword between his legs is depicted as if he is standing in front of the throne instead of sitting; His throne is like a bench that rests on two winged horses in front, the winged horses at the legs of the throne face the king like men behind the king. On the bed, there are patterned pillows, and on the edges of the bed, a circular pattern in the shape of a pearl is designed. Here, the coldness and dryness of the king's sitting position on the sofa has a religious meaning, as well as the decorations of the bed and furniture have a ritual and symbolic function (Figure 14).

Figure 14. Sasanian silver tray. Khosrow I (579-531 AD), diameter 28.3 cm. Hermitage Museum (Source: www.tamadonema.ir)

Data Analysis

In this section, the furniture or thrones and court carved on Sasanian silver vessels are analyzed and examined in terms of their relationship to the motifs, their structure and composition in the plates, and the meanings of the various patterns drawn on them:

A- Subjects engraved on Sasanian silver vessels

Sasanian court silver vessels mainly contain subjects such as scenes of royal feasts and official ceremonies. In some plates, the king is seated on the throne while officials and high-ranking officials, and sometimes musicians, are present on the scene. Subjects such as the granting of the royal ring, victory over the enemy, or battle scenes that exist in Sasanian stone carvings are not seen on court silver plates. On the surface of most Sasanian silver plates, scenes of hunting and royal feasts are seen, which have a symbolic aspect because the ancient allegory of hunting and war means the defeat of worldly and spiritual enemies. Also, in the scenes of the feasts of kings and musicians playing; the king is sitting on the throne alone or with the queen. Some of these motifs have a formal aspect or indicate a symbolic narrative of victory in war or the celebration of the awarding of the royal badge. Similarly, the design and pattern of the furniture are also designed in an allegorical way in line with these ceremonies and narratives. Therefore, the design of the narrative and events in the Sassanid plates can be followed in an allegorical way in the Sassanid silver plates, and the reality is not objectively but is taken from the current customs of that period and is recorded in a symbolic way.

B- Types of furniture engraved on silver dishes

The design of furniture in the Sassanid silver plates has several different types. In most cases, it is in the form of a bed and a couch, which is believed to be made of high-quality wood and has symbols, metaphors, and ornaments common in Sasanian art. In other cases, it is seen in the form of mats decorated with designs and patterns appropriate to the ceremony in which the king and sometimes the queen or prince are present. In some cases, mats and backrests decorated with geometric or plant motifs are placed on a wooden bed. Most of the beds are flat and rectangular with thick, hourglass-like bases, and in some cases, they are vase-shaped and designed with the influence of Sasanian arch architecture. The bases of some royal beds also include statues of animal bodies such as a ram, griffin, winged horse, lion, or other mythological animals that had a symbolic aspect that held the bed on top and were mainly known as the king's protectors and guardians or sources of good and blessings. The crescent moon pattern above the king's throne or crown also had the same meaning. The angel pattern on the base of one of the thrones is also influenced by Rome and mostly related to the late Sassanid period, possibly carved by Roman prisoners, like the one carved on the entrance of Taq-e Bostan in Kermanshah from the Sassanid period. Some of the thrones were also smooth and the wheel pattern below them was more

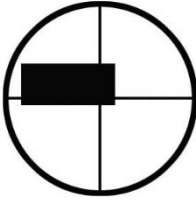functional, although it may be linked to the seal or sun wheel according to ancient Iranian tradition.
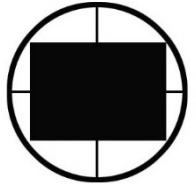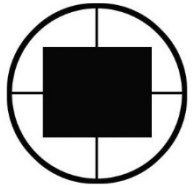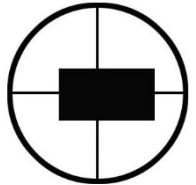
C- The location of furniture in silver dishes

The location of the furniture, the throne or the mattress, which is the seat of the king and queen, is mainly in the center of the circular frame of the plate to emphasize the importance of the king's dignity and position. In some plates, the king also spreads his legs symmetrically and sits on the throne to emphasize more on the center of the image, which is himself. On the other hand, the depiction of the bodies and faces of people in a frontal or frontal position in ancient Iranian art indicated a dry, formal and religious state. In Sasanian art, especially in metal plates and rock reliefs, "mirrorless symmetry" is considered a special element of Iranian composition, which both emphasizes the center of the image and, by making the image different and larger, creates a "official perspective", except in subjects such as the promenade, where the king and queen are depicted in a dynamic manner and lack formal expressions; the mat on which the king and queen are sitting is depicted near the edge of the circle of the plate, and of course, in most cases, except for one case to show the king's family dignity, it is depicted in the upper corner of the plate.
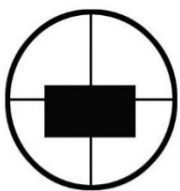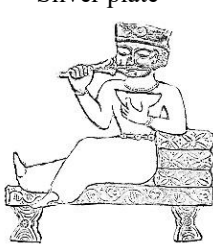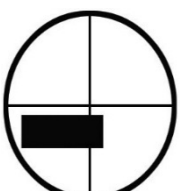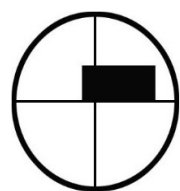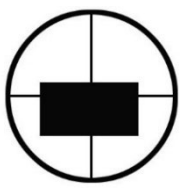
D- Designs drawn on beds and mats
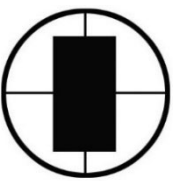
The main designs drawn on beds and mats are plant and geometric or spiral designs that have a decorative aspect and are considered a signature and representative of the specific style of Sasanian art due to the influence of other Sasanian arts such as stucco, reliefs, fabric designs and architectural decorations. In addition, the influences of Roman designs and Greek mythology such as angels, especially in the late Sasanian period, were used in the design of plates to promote and advertise religious customs and rituals as well as to demonstrate the authority of the Sasanians. Based on what has been stated, Table 1 shows the types of designs and patterns carved on twelve selected silver plates from the Sasanian period, as well as the subjects or occasions and the location of the beds or mats on the dishes.

Table 1. Descriptive analysis of the design and pattern of Sasanian silver plates (Source: author).

Placement of the bed on the container	Motifs		Topics, structure and meaning	Linear design of various types of furniture	Sasanian silver dish	Row
	Mattress	**Flat**				
	Geometric plant motifs	Simple without base	Subject: A royal feast scene with courtiers, dancers, and musicians present. Meaning: Promoting customs and rituals, the king's companionship with the masses, and a display of the king's authority and sanctification.	Silver plate		1
	Geometric plant motifs	Geometric plant motifs	Subject: Informal royal banquet, Bahram bestowing the royal insignia on the enthroned queen. Structure and meaning: The sacredness of the ceremony, the authority and dignity of the king's position.	Silver plate		2
قطربشقاب:۱۹س.م	Geometric plant motifs	Geometric plant motifs	Subject: Informal royal banquet, the king bestowing the insignia of royalty on the queen. Structure and meaning: pomp, royal grandeur and authority, symbolism, promotion of culture	Gold-plated silver plate		3
	-	Simple, without decoration. Circular base with two angels.	Subject: Mythological victory ceremony of Dionysus. Structure and meaning: Symbolic and ritualistic dynamic influenced by Rome and Greece.	Gold-plated silver plate		4

	plant motifs	Geometric plant motifs	Subject: Royal feast scene with dancers and musicians. Structure and meaning: Image dynamics, royal authority, decoration and ritual	Silver plate 	5
	-	Geometric plant motifs	Subject: The Shah's hunting lodge with his retinue. Structure and meaning: Dynamic, symbolic and informal, a display of authority	Silver plate 	6
		The bed legs are in the shape of a winged horse and the edges of the bed are spiral-shaped. -	Subject: Royal feast scene with musicians playing. Structure and meaning: Image dynamics, spatial, symbolic and ritual perspective, and sacredness	Gold-plated silver plate	7
	Geometric patterns	Bed legs in the shape of a winged horse	Subject: Royal feast and hunting scene. High-ranking officials and attendants stand respectfully by the throne. Structure and meaning: Symmetry, facing and religious, sanctity	Silver tray 	8
	. -	The bed bases are two mythical winged creatures.	Subject: The scene of the royal ring taking. Structure and meaning: Asymmetrical symmetry, royal authority, ritual and religiousness, and sanctity	Silver plate 	9

	-	The bases of the floating bed have decorations in the Sassanid architectural style.	Subject: Mythological narrative scene of the god of rain sitting on a moving throne in the shape of the moon. Structure and meaning: dynamic and symmetrical, religious and ritualistic, mythological, authority and sacredness.	Gold-plated silver plate	10
	-	The bed inside the crescent is located on four wheeled pillars.	Subject: Mythological narrative of the rain god with war implements on a moon-shaped floating throne. Structure and meaning: dynamic and symmetrical, religious and ritualistic, mythological, authority and sacredness.	Gold-plated silver plate	11
	Geometric patterns	The bed legs are in the shape of two falcons.	Subject: Royal feast of the granting of the royal ring. Structure and meaning: symmetrical and static, symbolic, ritual and religious, and sacredness	Oval silver bowl	12

Conclusion and Suggestions

By examining the art of metalwork and Sasanian silver plates, it was determined that Iran had the most valuable artistic achievements during the Sasanian period. The tradition of patterning in all the surviving works of art of the Sasanian period was directly related to the ritual and religious beliefs of the Sasanians, and in a way, the arts were the representatives and propagators of their religion, culture, and religion. With the development of the art of metalwork and the advancement of manufacturing techniques and various methods in decorating vessels, the Sasanian period is considered one of the most influential periods in the spread of metalwork art. In fact, most of the visual symbols of Sasanian art are also reflected in the designs of the vessels. For example, on most of the metal vessels, the official image of the kings with special signs of royalty, crowns, and special ornaments, can be seen sitting or reclining on the royal throne. By examining the designs and symbols on Sasanian vessels, the apparent structure of furniture in this period was mostly in the form of royal beds and couches, and in some vessels, beds are seen as chariots for carrying mythological gods. This furniture is mainly carved on vessels in three forms: beds, mattresses, and mats, and beds and mattresses together, and has symbolic designs and arrangements appropriate to the themes and occasions of feasts and battles. The seats of the beds were flat and covered with mattresses made of patterned fabrics or animal skins, and pillows with beautiful and symbolic designs were designed on them. The bases of some beds are simple

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and sometimes designed in the form of an hourglass or spindle, but the court beds, which are often engraved on plates during the crowning ceremony, have bases with symbols of mythological animals and more decorations. The symbolic themes of the motifs in Sasanian art are more important than their historical or narrative meanings. Thus, Sasanian decorative motifs, including birds, animals, and plants with allegorical and symbolic motifs such as angels, horses, winged cows, and mythological animals, engraved on the throne, court, and mats, can be interpreted as visual metaphors that narrate the social, ritual, and religious rituals of the Sasanians. On the other hand, the intricate motifs on metal plates, like other Sasanian arts, can be considered a crystallization of the power and authority of the Sasanian kings and the propagation and dissemination of Sasanian culture in the ancient world, because placing the king, queen, and courtiers in the center or the best place in the image visually and occasionally showing them larger among the individuals is a repeated emphasis on the power and importance of the king and his family. The images engraved on the plates can be categorized into two general types in terms of the design structure, which also influenced the type of furniture display: "static" which includes purely religious narratives and mainly shows the king in the center of the image, and "dynamic" which includes musical and informal narratives emphasizing the king's companionship with the people and religious customs while maintaining authority. The authority of the king's sitting on a mat in informal situations and his placement somewhere other than the center of the frame also implicitly represents the king's theatrical companionship with the people who, during the Sasanian period, mainly sat on mats and on the ground. The king placing himself on the same level as myths and alongside the gods, such as the scene of receiving a royal ring from Ahura Mazda, was also intended to express the credibility and legitimacy of the Sasanian king's rule over the people. However, basically, the throne and the couch were always associated with power, and the court's purpose in displaying furniture on silver plates should be considered an expression of power. In the design of silver plates, motifs and symbols influenced by Greek and Roman art are sometimes seen, such as the humanization of Ahura Mazda and angel motifs in the late Sasanian period. In the continuation of this research, it is suggested that the design and pattern of furniture be studied from semiotic and iconological aspects to reveal newer aspects of Sasanian art that had its roots in the dynamic culture and society of ancient Iran.

Author Contributions

All authors contributed equally to the conceptualization of the article and writing of the original and subsequent drafts.

Data Availability Statement

Not applicable.

Ethical considerations

The study was approved by the Ethics Committee of the Yazd University. The authors avoided data fabrication, falsification, plagiarism, and misconduct.

Conflict of interest

The authors declare no conflict of interest.

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References

Ameh. P. (2011). *Art of the Ancient Near East Elam*. Auvers-Sur-Oise. French:Macomilo. 54

Cooper, J. C. (2008). *Illustrated Culture of Traditional Symbols* (Karbasian, M. Trans.). Tehran: Farshad Publishing.

Durant, W. (2011). *History of Civilization Ahmad* (Aram, A. Trans.). Volume 1 (Eastern), 14th Edition, Tehran: Scientific and Cultural Publications.

Esfandiari, A. (1998). The History of the Chair and the Lotus Flower in Archaeological Evidence. *Journal of Archaeology and History, 2*, 11.

Fariyeh, R. W. (1995). *Iranian Arts* (Marzban, P. Trans.). Tehran: Farzan Far Publications.

Hall, J. (2004). *A Pictorial Dictionary of Symbols in Eastern and Western Art* (Behzadi, R. Trans.). Tehran: Roshanfekran Publishing House.

Holmes. E. N. N. (1969). *The Representation of Costumes in the Reliefs*. London: Artibus Asiae, 224-229-238.

Kristen, A. (2003). *Iran in the Sasanian Era* (Yasemi, R. Trans.). Tehran: Contemporary Voice Publishing.

Lukonin, V. G. (1971). *Sassanid Iranian Civilization (History of Iranian Civilization in the Sassanid Era)* (Enayatollah, R. Trans.). Tehran: Book Translation and Publishing Company.

Mohammad Panah, B. (2006). *Collection of Ancient Iranian Works in the Great Museums of the World*. Volume 1, Tehran: Sabzan Publishing House.

Mousavi, M., & Pourmand, K. (2010). A Study of the Motifs and Their Evolution in Ancient Iranian Thrones. *Negreh Magazine, 15*(53).

Pope, A., & Ackerman, Ph. (2008). *Masterpieces of Iranian Art* (Khanlari, P. Trans.). Volume 2, Sassanid Period, Tehran: Scientific and Cultural Publications.

Rahmanpour, N. (2007). *Stylistics of Iranian Furniture (4000 BC- End of the Qajar Era)*. Master's Thesis, Al-Zahra University, Faculty of Art, Tehran.

Shakuri Far, M., & Nasrollahzadeh, S. (2016). Pursuit of Iranian Traditions in Parthian Coins. *Journal of Historical Essays, 7*(1).

Yahghi, M. J. (2000). *A Dictionary of Mythology and Fictional Symbols in Persian Literature*. Tehran: Soroush Publishing House.

Retrieved from: www.kherada.com.2015/02/30Faryba Saghari

Retrieved from: www.ariai.com.2015/08/23Anush Ravid

Retrieved from: www.memarima.ir.2015/01/10Mina Yasemi

Retrieved from: www.tebyan.n et.2012/07/22Marim Mehrabadi

Retrieved from: www.parsiandej.ir.2018/03/13. Shamshad Amiri Khorasani

Retrieved from: www.tamadonema.ir.2017/06/28Milad Mousavi

Study the Role of Culture in the Design of World Cup Mascots with Emphasis on the Mascots from 2006 to 2022[1]

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Article Info	ABSTRACT
	One of the significant global events that, beyond the sporting arena, has a cultural and social impact is undoubtedly the FIFA World Cup, which was first held in 1930. Nearly 95 years after the inaugural event, its audience has grown to a level where its cultural, social, and economic dimensions are just as prominent as the sporting aspect. Hosting the World Cup is perceived not only through an economic lens but also as a platform to showcase the culture of the host countries. The visual identity of the tournament, which began with the design and selection of a mascot (Willie) in the 1966 World Cup, has become the most important avenue for promoting the host culture. The mascot's identity—including its species, skin color, clothing color, and name—reflects the symbolic images or concepts of the host countries. Therefore, this study aims to analytically and descriptively examine the relationship between World Cup mascots and the culture of the host nations, using the mascots from 2006 to 2022 as case studies. This research highlights key findings, including the predominant use of national colors (colors from the flag) and the symbolic choice of animal or object that captures the essence of the host culture, offering insights into how these mascots serve as a bridge between sports and cultural representation on a global stage. In the 2006 World Cup, a lion was chosen as the mascot; in 2010, it was a cheetah; in 2014, an armadillo; in 2018, a wolf; and in 2022, a keffiyeh. Among all these animals, only the keffiyeh, a cultural item, represents the Qatar World Cup. With the exception of the 2006 World Cup in Germany, where the selected animal had no connection to the local culture and environment, the remaining mascots reflect the identity and wildlife of their respective host nations.

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[1] Derived from a master's thesis in the field of Graphic Design titled "A Study of Character Design (Mascots) for the FIFA World Cup and Its Relationship with Host Culture, Focusing on the Mascots from the Years 2006 to 2022".

Introduction

One of the most significant, impactful, and popular events in the world is the FIFA World Cup, held every four years, capturing the attention of football and non-football enthusiasts alike from around the globe. The host country of this tournament makes extensive preparations long before the scheduled date to ensure that this global event is conducted with grandeur, including the visual design of the matches, which is crafted by prominent designers and revolves around the emblem of the tournament, expanding and developing from it. The emblem of the tournament was first utilized at the 1966 World Cup in England, and since then, it has become a consistent tradition in hosting this event. The emblem is a representation of the host nation's culture and history, making each tournament unique and special. For instance, the emblem for the 1998 World Cup in France was "Footix," a rooster that is one of the national symbols of France. The phrase "France 98" is inscribed in white on the navy-blue rooster, Footix. The color scheme is inspired by the flag of the host country and the uniform of the French national team. The host nation is making an effort to seize the opportunity to showcase its culture and history through a symbol, thus paying particular attention to the design process.

Research Background

An analysis of the indigenous symbols of the mascots from the Summer and Winter Olympics in Japan, South Korea, and China, a Master's thesis in Visual Arts, Higher Institute of Art (Hamidi, 2021). The findings of this study indicate that the three mentioned countries have significantly incorporated their national signs and symbols into the design of their mascots. Additionally, the culture and identity of each country have played a critical role in shaping each mascot, using the major Olympic event as a medium to reflect the style and culture of the host country.

An Examination of the Cultural and Social Dimensions of Mascots, Master's Thesis, Department of Visual Arts, Al-Zahra University (Khodaei, 2009). One of the advertising methods is the use of mascots. A mascot is a symbol chosen for a product or event to facilitate more effective promotional and commercial activities. Mascots encompass advertising, commercial, and cultural-social aspects; however, since mascots are considered a novel phenomenon in advertising and graphic art in our country, it is essential to understand their impact on society and culture. A mascot is not merely a representation of a product; it can also symbolize a culture, a belief, or a value system. Furthermore, it can be asserted that mascots influence societal culture while also being shaped by it.

The design of the brand personality model for the Iranian Premier League, doctoral dissertation, Graduate School of Physical Education and Sports Sciences, Sports Management Research Institute (Tabatabaiyan, 2018). The results of this research indicated 11 main categories

organized within a paradigmatic model, including the characteristics of the league's brand personality as the core category. It also encompassed causal conditions (organizational characteristics, team characteristics, performance, fans), contextual factors (product-related and non-product factors), intervening conditions (external environment), strategies (direct and indirect resources), and outcome factors (communications and the league's brand personality).

If the Premier League can design a persona that aligns with its objectives and effectively communicate it to its audience, this persona will enhance preferences, increase loyalty, and strengthen customer relationships. A study examining the visual characteristics of sports club logos in Iran and their influence from European clubs (Fallahzadeh Abraghui, 2014) reveals that the design of Iranian club logos incorporates features such as an emphasis on form and the use of shapes like circles and triangles, the inclusion of Persian and Latin letters, and the presence of symbols such as balls, trophies, shields, and human or plant motifs. Furthermore, there is a variety and richness in color usage in these logos, alongside the observation of traditional motifs and historical artifacts derived from national identity, which play a significant role.

Methodology

The present research is qualitative, utilizing a descriptive-analytical approach. The information collection method employed in this study is library-based, utilizing tools such as note-taking from books and articles, as well as drawing on relevant visual resources associated with the topic. The case studies examined in this research are the mascots of the FIFA World Cup from 2006 to 2022.

Culture

Definition of Culture

Linguistically, culture refers to knowledge, virtue, literature, and intellect (Moein, 1981: 2538). Culture has been termed a national heritage. In general, the meanings and concepts derived from culture in Persian encompass a collection of knowledge, beliefs, arts, ethics, laws, customs, and acquired habits of all human beings (Mansouri, 1995: 6). The precise application of the term "culture" was first used by Taylor, an English anthropologist. In his book titled "Researches into the Early History of Mankind and the Development of Civilization," published in 1865, he occasionally refers to the term culture, yet he predominantly employs the term civilization.

In 1871, the name of primitive culture was assigned to his main book, and in its opening sentence, he provided the first official and clear definition of culture. This date can be regarded as the birth of this scientific concept, although its foundations had been laid in the German language prior to this (Ashouri, 2002: 76). Taylor states: Culture is a complex whole that includes

knowledge, beliefs, art, morals, law, customs, and habits that an individual inherits from their social environment (Taylor, 1871: 96).

General Characteristics of Culture

A collection of commonalities constitutes the general and overarching traits of the cultures of various peoples and nations, as described below:

Acquisition: Culture is not an inherited legacy passed on instinctively to individuals; rather, it is a series of habits and experiences learned by humans throughout their lives.

- Transferability: Cultural issues are transferred from one generation to another based on the talents and interests of individuals.
- Social Nature: All customs and habits that constitute the culture of a nation have a social aspect, rather than being individual.
- Meeting Basic Needs: The primary and subsequent needs of human life are fulfilled within the framework of culture, and the means of responding to major natural events and transformations, or conquering and reshaping nature to meet human needs, is attained through culture.
- Constant Change: All cultures in the world are perpetually evolving. Research indicates that cultures are created, exert dominance and influence, and ultimately fade away, making room for new cultures.
- Stability: Although culture is relatively stable, it is also subject to change, with transformation being a hallmark of cultures. However, such change occurs gradually.
- Political, Cultural, and Economic Standards: Culture often evaluates and positions itself concerning its characteristics and context regarding relevant issues. Politics seeks to acquire power, while culture is diverse and borderless, often conflicted with the self-serving intentions of politicians and economists (Ghafouri, 2002: 132-134).

Cultural geography

Cultural geography examines the spatial differences and changes in language, economic systems, forms of government, relationships, perceptions, environmental interpretations, and various other cultural components. Cultural geographers believe that the entirety and form of culture cannot be accurately understood without considering the environment in which it has developed. Additionally, these geographers engage in environmental analysis, such as studies on climate, vegetation, soil, and wildlife, and incorporate these elements into their research, as they significantly influence culture and aid in elucidating cultural patterns.

Cultural geography is devoted to describing and analyzing the ways in which differences and similarities in language, religion, economy, governance, and other cultural phenomena manifest from one location to another. Rather than focusing solely on the human environment, it emphasizes human culture. Thus, cultural geography is a branch of geography that investigates culture in its broadest and most general sense, encompassing human and social achievements.

In geography, culture includes a vast range of knowledge, art, values, economy and livelihood, religion, customs, and ideology, which is perceived as a systematic and holistic framework, with relatively extensive discussions on these aspects. From its definitions, it is evident that cultural geography is an interdisciplinary field that examines how differences, patterns, and the distribution of cultures form under a cultural system in the context of space and in relation to time. Its aim is to recognize and explain cultural homogeneities and heterogeneities, or, in other words, the spatial uniformity or diversity of cultures.

Mascots

The Persian term "mascot" has been suggested to be equivalent to "good luck charm," yet this lexical equivalence is not particularly illuminating, as the term carries a connotation that is significantly broader than that of a simple good luck charm. Consulting reputable dictionaries, the conventional meaning of "mascot" is closer to: "a person, animal, or object that brings good fortune." This symbolic figure is commonly employed by organizations and groups, such as sports teams (Oxford Dictionary, 2010). Another definition of "mascot" considers its graphical application: in graphics, it serves as a fusion of performance art, painting, and graphic design aimed at creating an appropriate context to highlight the identity of what is to be presented, whether human or non-human in form. In graphic design, these structures can also manifest as elegantly designed promotional packages. Often, this type of personalized identity representation must pursue a specific objective; in a way, the graphic designer, by acknowledging reality, endows the depicted character or structured package with a quasi-human life, utilizing aesthetic sensibility and purposeful creativity to evoke and reinforce the impermeable beliefs and mentalities of viewers, compelling them to unwittingly fall under the allure and temptations of the mascot's beauty (Arwahi Azar, 2016: 49).

Mascot Classification

Educational Mascots: Educational mascots are symbols that schools, colleges, and universities adopt. These mascots are utilized during formal ceremonies and sporting events to represent these educational institutions. Their use in sports is confined to college and school competitions, specifically targeting student groups. Currently, nearly every school, college, or university in the United States and Canada has a mascot (Mirkarimi, 2008: 79).

Among the most well-known educational mascots is the University of Minnesota's Golden Gopher, which has a history spanning over 150 years. The most popular category of mascots in American educational institutions is animal mascots, with the most frequently used animals being eagles, various types of felines, and bulldogs (Hubpages, 2010).

Figure 1. University of Minnesota Mascot (Golden Gopher) (Source: http1)

Commercial Mascots: Commercial mascots are symbols utilized by businesses, manufacturing plants, restaurants, and others. Through these mascots, the names of these commercial entities are popularized, and their products become widely recognized among the public. Every manufacturing company faces hundreds, if not thousands, of competitors producing similar products at comparable prices, while their consumer bases remain constant. In this intense competition for attracting new customers, mascots play a crucial role in retaining the company's clientele. Mascots facilitate easier recall of each company's name and its products for consumers. Consequently, a significant portion of advertising and customer engagement is achieved through commercial mascots, allowing restaurants, factories, or any other business to establish connections with the community and the media (Mirkarimi, 2008: 97).

Figure 2. Cheetos Monkey, the brand mascot of Cheetos (Source: http2)

Military Mascots: A military mascot is a domesticated animal that an army maintains for ceremonial purposes, serving as a symbol (ibid, 101). Many British military regiments use live animals as mascots, showcasing them in public displays alongside the regiment during parades. For instance, the live mascot of the 95th Derbyshire Regiment is a ram; the Irish Guard has an Irish setter; the Argyle and Sutherland Highlanders have a Shetland pony for their mountain units; and the Royal Welsh has a goat. The Bengal tiger of the fifth battalion of the Australian Army, known as W. O. Quintus, is also a live mascot but is kept at the Taronga Zoo in Sydney due to the danger it poses to spectators and fans, and does not participate in parades. The Royal Guard of Norway has a live mascot, an emperor penguin named Nils Olav, as well as the Nazi army mascot, which was an eagle.

Figure 3. Mascot of the Nazi German army (Source: http3)

National Mascot: The totem was a symbol chosen by humans in ancient times, which held profound significance for them. Throughout history, totems have gradually evolved and been depicted on the flags or insignias of nations. Social science informs us that the primary society, although the simplest form of gathering, is indeed a familial, economic, political-religious, and cultural community. The collaboration, coordination, and cohabitation of the individuals gathered is based on their similarity and shared needs. Ultimately, they are all akin to one another because they all partake in the totem, which is a special symbol of the clan. A totem can be a living or inanimate entity, often represented by an animal or plant that the collective perceives as their ancestor. They identify themselves by this entity, adopt it as a symbol of their identity, and hold it in reverence.

Figure 4. National Mascot of the United States of America (Source: http4)

Sports Mascots: Sports mascots symbolize teams and major sporting competitions such as the Olympics, Paralympics, World Championships, Continental and National events, etc. In significant sporting events, mascots play a pivotal role (ibid, 17). Each tournament of the World Cup, while promoting and elucidating the history, culture, and even geography of the host nation, creates a joyful and energetic atmosphere. Each edition of these competitions conveys a specific message to the world. Mascots are important media for transmitting the message of competitions to human societies, especially to children and youth globally. The foremost characteristic of World Cup mascots is that they must express the philosophy and deep spirit of the games while simultaneously showcasing the unique attributes of the host countries.

Physical Characteristics and Traits of Mascots

Mascots typically embody one of five physical traits, and since they are crafted from human thought, they universally possess a structure that aligns with human movement.

- An animal appearance with human movement.
- The appearance of plants and vegetation with human movement.
- The appearance of objects with human movement.
- A human appearance with movements beyond human capabilities, or with the same human essence.
- A combination of two or more appearances (objects, imagination, animals, etc.).

It is evident that a mascot does not need to possess the structural features that have become a style and culture in our modern world. Rather, the way materials are utilized in their construction, akin to the use of wood in the simulated structure found in the children's story of Pinocchio, is entirely innovative and based on personal taste (Arwahi Azar, 2016: 55).

By examining successful mascots, one can observe the following characteristics:

- They define the identity of a specific group or profession.
- They are often changeable.
- They have a childlike structure.
- They feature vibrant colors.
- They exhibit exaggerated appearances and hold a human nature.

World Cup Mascots

Sports mascots first showcased their presence in the realm of athletics during the World Cup. From the first mascots to the latest ones, we observe a gradual evolution in design.

Table 1. Gradual evolution in design

Mascot image	Descriptions	Mascot name	Tournament Host	Year of Holding
	For the first time at the World Cup 1996 in England, a mascot was designed for the tournament. It was a lion named Willie, who played football. Willie's message was that football competitions are meant to be entertaining and that the contests are friendly in nature. His shirt was designed in the shape of the English flag, with the words "World Cup" inscribed on it. The lion is an important symbol of England.	Willie	Uk	1996
	At the World Cup 1970, a cheerful little boy named Juanito, dressed in the colors of the Mexican national team, became the mascot for the tournament.	Juanito	Mexico	1970
	Two German boys named Tip and Tap, who have "WM74" on their chests. "WM" stands for Weltmeisterschaft, meaning World Championship, while the number 74 indicates the year this tournament was held. Their facial features are inspired by typical German children, and they are wearing the German national team's jersey.	Tip & Tap	West Germany	1974

	A native American boy dressed in the Argentine national team's outfit, wearing a blue hat with "Argentina 78" inscribed on it. Gachito carries a yellow scarf and a typical gaucho's poncho; these accessories are commonly associated with gauchos, the skilled horse riders known for their bravery, and serve as a national symbol of Argentina.	Gauchitto	Argentina	1978
	Naranjito is a smiling orange. Oranges are a popular fruit in Spain. Naranjito wears the uniform of the Spanish national team, and his name is derived from the Spanish word for orange.	Naranjito	Spain	1982
	A spicy jalapeño pepper sporting a mustache and a sombrero, dressed in athletic wear. The people of Mexico use this spicy pepper in their dishes.	Pique	Mexico	1986
	The symbol of this era is a tricolor figure with a head resembling a soccer ball and is actively playing. Its body is adorned in the three colors of green, white, and red, which are the colors of the Italian flag. "Chao" in Italian means healthy and is a form of greeting.	Ciao	Italy	1990

	Striker is a cheerful dog who is the second mascot observed in the World Cup. He wears a sports outfit in red, blue, and white, inspired by the colors of the American flag and the uniform of the U.S. national soccer team. His jersey features the inscription "94 USA."	Striker	United State of America	1994
	Footix is one of the national symbols of France. On Footix, the colors of the emblem bear the phrase "France 98" in white. The color scheme is inspired by the host country's flag and the uniform of the French national team.	Footix	France	1998
	The three mascots of this tournament are depicted in orange, purple, and blue, and all three are digital creatures. These three members form a fictional team named Atom Ball, resembling a soccer team. Ato serves as the team's coach, while Kazu and Nik are the players. Their names were selected through a public voting process.	Ato, Kaz & Nik	Korea and Japan	2002

Analysis of World Cup Mascots from 2006 to 2022

World Cup Mascot of 2006

Goleo derived his name from his father, who always encouraged him during football games with the phrase "Go, Leo, go!" The name is a blend of the English word "goal" and the Latin word "leo," meaning lion. FIFA added the number VI (six) because he was the sixth candidate to receive the title of World Cup mascot, coincidentally corresponding to the year 2006. Goleo stands at 2.5 meters tall, and his shoe size is 58. This character's costume is designed to house a performer inside. The movements of his mouth and arms are controlled by the puppeteer's hands. An onboard camera in the lion's eye transmits images to a display inside the costume, allowing the performer to navigate. The lip movements of his sidekick, a ball named "Piele," are controlled externally by another puppeteer.

Figure 5. Goleo, the mascot of the World Cup / Germany 2006 (Source: http5)

Goleo stands like a human on two legs and is capable of performing human activities. He wears a white shirt with the number 6 and sports shoes. His friend and companion is a ball named Pille. In the selected mascot for the 2006 World Cup in Germany, there are fewer signs related to the host country's culture. The chosen animal (lion) has no connection to Germany because if an animal were to be selected as a mascot, an eagle would have been a better option. The white outfit, although reminiscent of the German team's kit, does not reflect the colors of the country's flag. The only black strips on the shirt and the shoes of this mascot allude to one of these colors. The choice of a ball as the lion's sidekick also has no cultural ties with the host country and is merely a ball that speaks in German. Perhaps Goleo's tall stature references the average height in this country. This mascot lacks any other noteworthy elements or symbols to lean upon. Overall, Goleo and Pille have not been a successful mascot throughout different World Cup tournaments, and there is no deep connection between them and the culture of the host country. This can be observed from the numerous criticisms directed at this symbol.

World Cup Mascot 2010

One of Africa's felines, the African cheetah, is found in southern and eastern Africa. This beautiful and swift animal became the inspiration for designing the mascot for the 2010 World Cup in South Africa, leading to the creation of a charismatic character named Zakumi. Zakumi is a cheerful, confident, adventurous, and energetic mascot. He loves football and always follows his instincts and intuition. Additionally, he is always playing tricks and joking with people, which brings them joy. This warm-hearted trait is a common characteristic among the people of South Africa. The people in this region are lively and joyful, which is why they embrace bright colors and music.

Figure 6. Zakumi; Mascot of the 2010 FIFA World Cup in South Africa (Source: http5)

On the one hand, the swift nature of the African cheetah has contributed to Zakumi becoming a speedy football player. Zakumi is an energetic teenager who loves football. This character can easily be found in the streets and alleys of South African cities, where children and adolescents transform into football players with just a T-shirt and sports shorts. Unlike the mascot of the 2006 World Cup, Zakumi does not wear sports shoes, which reflects his instinctual and intuitive spirit, drawn from the people and pure culture of South Africa. The colors used in this mascot draw inspiration from the South African flag: green and yellow. The writing on Zakumi's white shirt is in black, and these two colors are also present in the country's flag.

Mascot of the 2014 World Cup

The term "Fuleco" is actually derived from the combination of two words: "futebol" (football) and "ecologia" (ecology). The name Fuleco garnered 48 percent of the vote and was chosen as the name of this symbol, which prominently features the colors yellow, green, and blue. Among all national symbols of Brazil, only the colors of the flag were used in the 2014 World Cup mascot. Fuleco is inspired by a rare animal called the armadillo, which has a hard shell on its back. Fuleco's shell is blue, its body is yellow, and its outfit is white and green. In the design of the hard shell, it is composed of hexagonal pieces resembling a football's outer layer, extending over its face between its two eyes. Few people would associate Fuleco with Brazil upon first sight (if we disregard the text on its outfit), and one can only guess that this mascot pertains to a football tournament. A notable theme in the design of this mascot is the emphasis on environmental support over other objectives.

Brazil is country rich in culture and abundant visual symbols. The flag of this nation is one of the few flags that features pictorial signs and is not limited to color representation. Its national emblem, as previously discussed, is filled with cultural and indigenous symbols of the land; however, the Fuleco mascot does not incorporate any of these subtle signs, rendering the character superficial and lacking identity. Furthermore, Brazil has always been among the foremost nations in football, and the Fuleco mascot does not adequately represent the country's

esteemed position in the sport, becoming a design that is aesthetically pleasing yet ultimately devoid of identity.

Figure 7. Fuleco; Mascot of the 2014 World Cup in Brazil (Source: http5)

Mascot of the 2018 World Cup

Zabivaka, the mascot of the 2018 World Cup in Russia, was designed by a 22-year-old student and was chosen as the official mascot through a public vote, surpassing two other designs (a cat and a tiger) with 53% of the votes. Zabivaka is a brown wolf with white paws and face, wearing red sports shorts and a white t-shirt with blue sleeves that reads: Russia 2018. The combination of white, blue, and red reflects the colors of the Russian flag. He wears orange glasses, which he often positions on his forehead. These glasses are meant to protect his eyes as he moves quickly on the football field, serving as a shield against the wind while he plays.

Figure 8. Zabivaka; the mascot of the 2018 World Cup in Russia (Source: http5)

The selection of the wolf as the mascot is appropriate given the cold, snowy climate of Russia and the perpetually frigid region of Siberia, as wolves typically inhabit snowy highlands and mountains. Zabivaka is from the Eurasian wolf species, which is one of the largest native wolf breeds found throughout Europe and Asia, particularly abundant in Russia. Thus, this type of wolf can be considered emblematic of the Russian landscape.

Mascot of the 2022 World Cup

La'eeb, inspired by the traditional Arab keffiyeh and agal, serves as a bright symbol of Arab nations, including Qatar, reflecting the cultural attire of the host country's inhabitants. The intricate Islamic patterns on the keffiyeh are derived from designs traditionally used by Arab women as tattoos. Essentially, La'eeb is a keffiyeh that has gained life and, like Arab men, bears an agal on its head; due to its fabric identity, it appears to float in the air. This levitating characteristic allows La'eeb to move swiftly and transition freely from one point to another like a bird. Consequently, some consider this mascot to resemble a spirit more than a mere keffiyeh!

Figure 9. La'eeb; Mascot of the 2022 Qatar World Cup (Source: http5)

Alongside the 1982 mascot (Naranjito), La'eeb is the second World Cup mascot inspired by objects, with the notable difference that La'eeb lacks arms and legs. This absence of limbs can be seen both as a characteristic and a limitation of the design. However, since the design is intended for a football tournament where physical suitability for the game is essential, La'eeb cannot serve as a fitting representative for a football festival. If we were to remove the "Qatar 2022" inscription, there would be no visual connection to the identity of football; it would merely represent an element for introducing an Arab country. Furthermore, La'eeb does not specifically represent Qatar and could be associated with all countries in the Persian Gulf region. Additionally, Qatar, as the World Cup host, does not have a notable reputation in the realm of football, nor does it stand among the top three teams in Asia, making it, so to speak, handicapped in football. Thus, La'eeb truly embodies the Qatari football team, which, despite its attractive appearance, lacks any fundamental capabilities (physical talent) in playing football. It merely claims to have been influential in many past World Cup goals, a statement that is solely a figment of its imagination. In conclusion, it can be said that the mascot La'eeb is not a suitable representative of the culture of not just Qatar, but of all Arab countries, and simultaneously, it is an inadequate symbol for a football festival.

Table 2. Mascots of the World Cups from 2006 to 2022 (Source: Author)

Indigenous Symbols Used in Mascot Design	Identity of the mascot	Meaning of the Name	Name of Mascot	Year of Holding	Host Country
The colors of the German flag (black and white) are utilized.	Animal	A fusion of the words "Goal" and "Leo," meaning "lion."	Goalie of the Sixth and Cocoon	2006	Germany
The colors of the South African flag (green, gold, white) are incorporated. The cheetah, a native animal of South Africa, is featured. The character, Zakumi, possesses a cheerful and engaging personality that reflects the spirit of the South African people. -The absence of sports shoes in this mascot signifies the country's love for soccer and the intuitive spirit of its people.	Animal	"Za" indicates *the* name of South Africa, and "kumi" means 10	Zacumi	2010	South Africa
The colors of the Brazilian flag are employed in the design.	Animal	A combination of the terms "futebol" and "ecologia," which translates to "ecology."	Fulko	2014	Brazil
A wolf is depicted as a cold climate animal. The colors of the Russian flag are integrated into the mascot design.	Animal		Zabiwaka	2018	Russia
Arabic headdresses and agals are included in the mascot design. Designs inspired by traditional Arab women's tattoos are utilized.	Objects	A highly skilled player.	La'eeb	2022	Qatar

Conclusion

Mascots, irrespective of their type and classification, represent a human group and their cultural showcase. This group can be a university, fans of a brand, or the people of a nation. What is important is that the success of a mascot necessitates the presence of a cultural aspect. Football, with its strong cultural background at both club and international levels, has created an arena for cultural exchange among different countries, facilitated by events such as the World Cup. In designing the mascot for World Cup tournaments, the designers first utilize visual-cultural elements from the host country, such as national colors (derived from the flag), as well as animal, plant, or object symbols and national emblems. Subsequently, the name of the mascot can reflect its local identity, and finally, its character and biography are drawn from the temperament, lifestyle, and customs of the host population. In designing the mascot for the 2026 World Cup, which will take place jointly in the United States, Canada, and Mexico, the designer has based the work on various symbols associated with these countries and has created the final design through their integration. The table below lists the different symbols of each country that represent their culture, geography, and customs separately.

Table 3. Cultural Symbols of the 2026 World Cup Hosts (Source: Author)

Country Name	Color Item	Animal Item	Plant Item	Object Item
United States of America	Blue, Red & White	White-headed eagle		
Canada	Red & White	Beaver	Maple Leaf	
Mexico	Green, White, Red	Golden Eagle	Cactus	Semberer hat

Author Contributions

All authors contributed equally to the conceptualization of the article and writing of the original and subsequent drafts.

Data Availability Statement

Not applicable.

Acknowledgements

The authors would like to thank all participants.

Ethical considerations

The study was approved by the Ethics Committee of the Islamic Azad University, Tehran Branch. The authors avoided data fabrication, falsification, plagiarism, and misconduct.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of interest

The authors declare no conflict of interest.

References

Araasteh Kho, M. (1990). *Critique and Perspective of Each Culture of Scientific-Social Terminology*. Tehran: Nashr Gostareh.

Ashouri, D. (2002). *Definitions and Concepts of Culture*. 3rd Edition, Tehran: Agah.

Arwahi Azar, M. (2016). *Magic or Propaganda*. Tehran: Nashr Goyesh No.

Bakhtortash, N. (2005). *The History of the Flag of Iran from Antiquity to Present*. Tehran: Behjat.

Chalabi, M. (2005). *Sociology of Order*. Tehran: Nashr Ney, 3rd Edition.

Ghafouri, A. (2002). *Definition of Culture and Civilization and Its Component Parts*. Gofteman, Issue 6: 121-156.

Moein, M. (1981). *Persian Dictionary*. Tehran: Amir Kabir Publishing.

Mansouri, J. (1995). *Culture of Independence and Development*. Tehran: Ministry of Foreign Affairs Publishing.

Mohaadi, M. (2004). *Determining the Characteristics of National-Islamic Culture*. Tehran: Secretariat of the Supreme Council of the Cultural Revolution.

Mirkarimi, S. T. (2008). *Maskat*. Tehran: Marlik.

Gesler, W. M. (1992). The cultural geography of health care. University of Pittsburgh Pre.

Hall, S. (1997). *Representation: Cultural representations and signifying practices*. London, Thousand Oaks, and New Delhi: Sage.

Hubpages. (2010). *Animal Totems and Familiars*. Retrieved November 4, 2010 from http://relache.hubpages.com/hub/Totems-Familiars

Little, W. (2016). *Introduction to sociology*. BC campus.

Oxford Dictionary of English, (2010). Oxford University Press, 3rd edition (January 1).

Pitzl, G. R. (2004). *Encyclopedia of human geography*. Greenwood Press, United State of America.

Taylor, E. B. (1871). *Primitive Culture*. Cambridge University Press.

1. https://tiermaker.com/categories/ncaa-sports/college-football-mascots-1621298

2. https://irannovin.net/english/brand/cheetoz/

3. https://www.slideshare.net/slideshow/nazism-and-fascism-166306354/166306354

4. https://fineartamerica.com/shop/stickers/eagle+eye

5. https://www.fifa.com/en/articles/world-cup-mascots-in-history

From Loom to Light: Electronics in Textile Art and Design

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ABSTRACT

The integration of electronics into textiles has transformed traditional fabric design and art into a dynamic, interdisciplinary field that bridges engineering, material science, and creative practice. Electronic textiles, or e-textiles, have evolved significantly since early explorations with conductive threads in the late twentieth century, advancing through developments in weaving, printing, and fiber-level integration. Weaving techniques enable the incorporation of conductive yarns and circuits directly into fabric structures, while printing approaches facilitate scalable fabrication of conductive patterns, sensors, and responsive surfaces. These methods provide the structural and functional foundation for smart textiles, which are capable of sensing, actuating, and even adapting autonomously. Applications now extend across healthcare, sports, defense, and fashion, supported by innovations in energy harvesting, flexible storage, and adaptive computation within fibers. In the domain of textile art, artists are actively exploiting these technologies to expand aesthetic expression and interactivity. Works by practitioners such as Maggie Orth, LigoranoReese, and Victoria Manganiello highlight how electronics enable textiles to become dynamic, data-driven, or responsive artworks, merging craftsmanship with interactivity. Contemporary fashion innovators like CuteCircuit have further demonstrated how e-textiles blur the boundaries between art, design, and wearable technology. Beyond static functionality, the future of e-textile art points toward bio-adaptive, self-powered, and battery-free fabrics that integrate soft robotics, wireless communication, and AI-driven adaptability, offering unprecedented potential for sustainability, immersion, and embodied interaction. This review highlights the historical development, fabrication strategies, artistic applications, and emerging challenges of electronic textiles. By synthesizing insights across both technological innovation and creative exploration, it underscores how electronics in textiles are reshaping not only material design but also cultural and artistic practices, positioning smart e-textiles as critical to the future of design, wearable systems, and interactive art.

Introduction

The application of electronics in textile design has emerged as a transformative field, bridging traditional fabric production with advanced technological innovation. By embedding electronic components such as sensors, conductive fibers, and microcontrollers into textiles, designers are able to create functional fabrics that go beyond aesthetic value, enabling new forms of interaction and utility. These so-called "e-textiles" or "smart textiles" are increasingly used in areas such as wearable health monitoring, adaptive fashion, and responsive interior design. For instance, garments integrated with biosensors can track physiological parameters like heart rate or body temperature, while textiles with embedded light-emitting diodes (LEDs) or shape-memory alloys can dynamically alter color, pattern, or form. Such integration not only expands the creative possibilities within textile design but also addresses contemporary demands for multifunctionality, sustainability, and user-centered innovation. Consequently, electronics in textile design represents a critical intersection of art, science, and engineering, fostering the development of intelligent materials that redefine both fashion and functional applications.

The history of electronics in textile design can be traced back to the late 20th century, when advances in conductive materials and microelectronics began to inspire experimentation within fashion and textile industries. Early developments in the 1980s and 1990s primarily focused on incorporating conductive threads and fibers into fabrics to create basic circuits. These initial explorations were limited in scope, often confined to prototypes and artistic projects rather than mass-market applications. However, they laid the foundation for the concept of "smart textiles," where fabrics could serve not only as aesthetic surfaces but also as interactive mediums capable of sensing and responding to environmental or bodily changes.

The evolution of this field accelerated in the early 21st century with breakthroughs in nanotechnology, flexible electronics, and wearable computing. Conductive polymers, micro-sensors, and lightweight power sources made it possible to design textiles with advanced capabilities such as health monitoring, temperature regulation, and real-time data communication. Today, electronic textiles are used across diverse domains, including sports, healthcare, defense, and fashion, reflecting a shift from experimental designs to commercially viable products. The growing emphasis on sustainability has also influenced this evolution, with researchers exploring renewable energy integration, such as solar-powered fabrics, and recyclable electronic components. Overall, the progression of electronics in textile design demonstrates a continuous move from simple conductive fabrics toward complex, multifunctional systems that redefine the role of textiles in both everyday life and specialized applications.

The field is typically dated to the late 1990s and early 2000s, when researchers began integrating sensing, interconnects, and computation directly into garments. An early landmark was the Georgia Tech "Wearable Motherboard™/Smart Shirt," which embedded a textile bus to route physiological

data (an archetype for health-monitoring wearables) (Gopalsamy et al., 1999). Soon after, industry demonstrations such as Philips' Lumalive (2006) showcased flexible, fabric-integrated LED matrices for dynamic visuals, signaling commercial interest in expressive, light-emitting textiles.

In parallel, open, stitchable toolkits like Leah Buechley's LilyPad Arduino (mid-2000s) lowered barriers for designers to prototype soft circuits through sewable microcontrollers, sensors, and conductive thread, accelerating experimentation across design schools and labs (Buechley et al., 2008).

As the area matured, definitions and taxonomies emerged. ISO/TR 23383 (2020) formalized "smart textiles" as textiles that reversibly interact with their environment, distinguishing them from merely "functional" textiles and mapping generations from passive (sensing) to active (sensing + actuation) to very smart (sensing + actuation + adaptation). This standard also identified application domains and standardization needs—an important step toward common terminology across research and industry (Sajovic et al., 2023).

consumer products, platforms such as Google's Project Jacquard with Levi's demonstrated capacitive, touch-sensitive textiles coupled to removable electronics, a form factor designed for laundering and everyday use (Loke et al., 2021).

Contemporary research pushes capabilities down to the fiber level and toward system-scale robustness. MIT's "digital fiber" (2021) integrated addressable chips along a drawable fiber to sense, store data, and even run on-fiber machine-learning inference when stitched into garments—pointing to fabrics as information media, not just sensor substrates (Wang et al., 2025).

Recent studies also extend textile sensing modalities (e.g., large-area acoustic/pressure textiles for gesture and respiration monitoring), illustrating how fabric architectures can implement distributed sensing without heavy wiring (Hughes-Riley et al., 2018).

Meanwhile, reviews highlight rapid growth across materials and processes (conductive yarns, printed conductors, embroidered interconnects, and laminated modules) paired with applications in medicine, sport, defense, and interior environments (Rotzler et al., 2021).

A recurring barrier to deployment is durability, especially washability and mechanical fatigue. Historically, developers borrowed tests like ISO 6330 (domestic laundering), but a dedicated e-textiles washing durability method has now been issued: IEC 63203-204-1:2023 for leisurewear/sportswear e-textile systems. Together with ongoing methodological work, these standards are beginning to make performance claims more comparable across products and labs (Tadesse et al., 2025).

Sustainability is another active thread: recent reviews call for design-for-disassembly, recyclable conductive components, and alternatives to perfluorinated coatings, given the multi-material nature of e-textiles and their end-of-life challenges (Sajovic et al., 2023).

In sum, electronic textiles have evolved from proof-of-concept garments and expressive LED fabrics into increasingly integrated, standards-aware systems capable of multimodal sensing, actuation, and on-fabric computation. The near-term research agenda spans (i) fiber-scale integration and interconnect reliability, (ii) power and energy harvesting tailored to soft substrates, (iii) validated, standardized testing (especially laundering and wear), and (iv) sustainable materials and product architectures—directions that will determine whether smart textiles scale from niche applications to ubiquitous, everyday platforms (Tadesse et al., 2025).

Weaving Electronic Textiles

The integration of electronics into textiles via weaving techniques has gained increasing attention as a versatile and scalable approach to creating functional fabrics. Traditional weaving methods enable the incorporation of conductive yarns, metallic filaments, or coated fibers directly into textile structures, offering flexibility in placement, patterning, and routing of electronic functionality. However, this process can affect both electrical and mechanical properties of the resulting fabric—factors such as weave density, yarn orientation, and substrate structure influence conductivity, durability, and feel. Weaving allows real-time integration of components during fabrication, but achieving wrinkle-free and reliable textiles remains a challenge, demanding careful adaptation of conventional equipment and materials (Tseghai et al., 2020).

Practical applications and prototyping strategies illustrate the breadth of weaving in electronic textiles. For instance, Georgia Tech's "Weaving Integrated Circuits into Textiles" demonstrates a method of embedding small surface-mount devices (SMDs) along flexible plastic strips woven into the fabric weft, combining electronics and textiles at an architectural level. Similarly, Google's Project Jacquard embeds metallic-alloy conductive yarns into standard looms, creating touch-sensitive fabrics that can be processed by existing manufacturing infrastructure—without altering fabric aesthetics or feel. These examples underscore how weaving serves as both a fabrication pathway and a design enabler, enabling e-textile systems that are structurally sound, visually coherent, and compatible with mass-production (Zysset et al., 2010).

Printing Electronic Textiles

Printing techniques are revolutionizing how electronics are integrated into fabrics, enabling scalable, customizable, and robust production of e-textiles. Screen printing remains one of the most prominent methods due to its simplicity, high throughput, and cost efficiency. It works by pressing a viscous conductive paste—typically silver- or carbon-based—through a patterned mesh directly onto fabric substrates. This approach ensures good ink penetration and adhesion, especially with flexible wearable materials, and supports roll-to-roll manufacturing. For example, screen-printed silver tracks have been used to create textile-based patch antennas capable of reliable Bluetooth

communication, as well as flexible biosensors combining silver ink and graphene oxide for influenza detection. However, challenges such as fabric rigidity due to layer thickness and potential cracking under repeated deformation remain areas of focus (Karim et al., 2017; Ojstršek et al., 2021).

Inkjet printing, in contrast, offers much finer precision and thinner conductive layers, making it ideal for high-resolution and flexible applications. Recent innovations include using inkjet-printed organic nanoparticle pre-treatments on textiles to improve adhesion and reduce surface roughness. This enables direct inkjet deposition of reduced graphene oxide (rGO) inks, producing conductive tracks that are breathable, comfortable, and more environmentally friendly—resistance levels are dramatically lowered from ~10^6 Ω/sq to ~10^3 Ω/sq. Additional advances involve formulating composite inks—such as graphene-silver blends—that balance conductivity and cost, and can be printed onto pre-treated cotton substrates to yield durable e-textiles with sheet resistance ranging from ~0.08 to 4.74 Ω/sq depending on layering. Other printing approaches, like gravure, transfer, and film-release techniques, are also emerging; for instance, transfer printing of silver nanowire conductive inks has demonstrated lightweight, flexible conductive fabrics with sheet resistance as low as 3 Ω/sq . Meanwhile, novel copper-complex inks that fully penetrate knitted fabrics and serve as seeds for electroless plating show promise for robust, stretchable, and durable e-textile circuits (Farraj et al., 2023; Karim et al., 2017; Onggar et al., 2020).

Smart Electronic Textiles

Smart electronic textiles—often termed smart textiles or e-textiles—are fabrics that actively sense, respond, and interact with their environment. These textiles integrate electronic components such as sensors, actuators, interconnects, power sources, and computing units at multiple scales, including fiber, yarn, fabric, coatings, or embellishments. They are capable of detecting stimuli like temperature, light, pressure, moisture, or pH, and can translate this into visual, thermal, mechanical, or electrical responses—forming dynamic, biomimetic systems. Functionally, smart textiles are categorized by their level of interactivity: passive textiles only sense environmental changes, active ones sense and react, while intelligent or very smart textiles go further by sensing, acting, and adapting autonomously.

Applications of smart e-textiles span multiple domains. In healthcare, they deliver continuous monitoring of vital signs such as heart rate, respiration, and movement, enabling early detection of medical conditions and facilitating remote care. In sports and occupational safety, they track biomechanical performance to prevent injuries and optimize training. Meanwhile, military and first responders benefit from real-time status monitoring, environmental sensing, and situational awareness via smart garments. Fashion and design also embrace e-textiles, enabling interactive garments, displayable fabrics, or responsive aesthetics. Emerging innovations even include battery-

free, IC-less smart textile systems that wirelessly harvest energy via electromagnetic coupling, eliminating rigid electronics from the textile structure altogether (Ruckdashel et al., 2022).

At the material level, conductive fibers and yarns form the backbone of most smart textile architectures. These are created by blending or coating traditional fibers (e.g., cotton, polyester, nylon) with conductive materials such as silver nanoparticles, carbon nanotubes, or conductive polymers like PEDOT:PSS. Such fibers enable seamless electrical conductivity within fabrics without significantly altering their flexibility or comfort. Recent work has demonstrated the feasibility of weaving and knitting conductive yarns into standard textile processes, producing fabrics that can host sensors, antennas, and circuits directly in their structure. These advances are essential for developing garments that are lightweight, washable, and durable while retaining their sensing capabilities (Zohoori et al., 2017).

Another critical element is energy harvesting and storage, which addresses one of the most persistent challenges of smart textiles: powering electronic functions without bulky batteries. Researchers are investigating textiles that integrate flexible photovoltaic cells, triboelectric nanogenerators (which generate energy from motion), and piezoelectric fibers that convert mechanical stress into electricity. For example, hybrid energy-harvesting fabrics can collect both solar energy and biomechanical energy during wear, providing a continuous energy supply to embedded sensors. Complementary innovations in flexible supercapacitors and fiber-based batteries are making on-fabric energy storage increasingly feasible, opening the path to fully self-sustaining wearable systems (Zhang et al., 2020).

Finally, adaptive and intelligent textile systems represent the frontier of smart e-textile research. These involve not only sensing and actuation but also real-time data processing and decision-making, often through integration with artificial intelligence. MIT's recent development of "digital fibers" that can store data, sense, and even perform machine learning inference when woven into a garment illustrates this paradigm shift. Such fabrics can recognize complex activity patterns or environmental changes without requiring separate computing modules, effectively transforming garments into self-aware systems. These adaptive capabilities open possibilities for responsive clothing that adjusts insulation, alerts wearers of hazards, or personalizes user interaction— merging fashion with functionality at an unprecedented level.

Electronic Textile Designing art

Artists today are transforming textiles into dynamic, responsive artworks by integrating electronics—creating pieces that move, illuminate, or interact with the environment. Maggie Orth, a foundational figure in the e-textiles realm, has crafted works like *Electric Plaid*, which harnesses conductive yarns, thermochromic ink, and embedded electronics to produce color-changing patterns within woven fabrics. Another compelling example includes the "fiber-optic data tapestries" by LigoranoReese, which embed fiber-optic threads into tapestries to visualize live

data—such as Twitter streams or flight patterns—as evolving light patterns across the textile. These practitioners push beyond traditional textiles by using light, motion, and electronics as expressive media in their art.

In gallery and performance contexts, electronics in textiles become extensions of narrative and interaction. As showcased in the "Pretty Smart Textiles" exhibition, wearable artworks like Nicky Assmann's musical-circuit dress, Evelyn Lebis's clear LED dress, and Meg Grant's "Apology Helmet"—which verbalizes a programmed apology—illustrate how e-textiles can blend wearable form with storytelling, sound, and emotion. On another front, composer-artist Nicola Woodham employs soft circuitry embedded in wearable garments—like her "Buffer e-textile jacket"—to control sound in live performance through touch and movement, using fabric-based sensors tied to microcontrollers. These examples underscore a convergence of tactile textile craft with electronics and programming, enabling multidimensional, interactive art experiences.

How artists using electronics in textile art

Artists across the globe are harnessing electronics to transform textiles into dynamic storytelling media—moving beyond static craftsmanship to interactive, conceptual art. For example, Maggie Orth, a pioneering technologist and artist, has created numerous works integrating conductive yarns, thermochromic inks, LEDs, and e-ink displays. Her portfolio includes pieces like *Electric Plaid*, dynamic color-changing fabrics, wearable musical instruments, and interactive garments such as the *Firefly Dress*, *Musical Jacket*, and *Fuzzy Apparatus*—all of which embody the fusion of textiles and electronics into expressive, responsive art. Likewise, the artist duo LigoranoReese developed "fiber optic data tapestries"—electronic weavings that visualize real-time data feeds, such as Twitter or flight information, in luminous patterns across the textile surface.

Beyond these innovators, other artists are exploring personal and social dimensions through interactive fabrics. Victoria Manganiello, for instance, intertwines cloth and computation in her installation *COMPUTER 1.0*, where dark liquid flows through woven tubes, controlled by Arduino microcontrollers to briefly form woven patterns like twill or houndstooth before dispersing—a poetic reference to early computational looms. Similarly, CuteCircuit, led by Francesca Rossi and Ryan Genz, pushes fashion into the digital era with garments like the *Hug Shirt*—a Bluetooth-enabled wearable that simulates the sensation of a hug—and the *Galaxy Dress*, featuring 24,000 LEDs forming the world's largest wearable LED display .

The future of electronics in textile art

As electronic textiles evolve, the realm of textile art is poised to embrace "bio-adaptive and ephemeral materials" that respond intuitively to human presence and environmental stimuli. Materials designer Scarlett Yang, for example, is pioneering lab-grown hydrogel composites that shift their texture and rigidity based on ambient humidity—grown from algae-dyed silk protein, these pieces exist at the intersection of biotechnology and artistry, pointing toward textiles that evolve and even degrade gracefully over time. Such creations underscore a shift from static art objects to *living fabric installations*—works that dialogue with space, time, and materiality, introducing temporality, fragility, and sustainability into textile art.

In addition, the next generation of smart textile art promises battery-free interactivity by leveraging wireless sensing and energy harvesting directly from the human body or nearby fields. Researchers in China have already developed electronic fibers that function without rigid components or batteries—activated via the wearer's touch and ambient electromagnetic energy to emit light or control devices—suggesting dramatic freedom in wearable art production. Likewise, entirely soft-logic garments like the pneumatic nylon jacket designed by Rice University display how soft robotics can drive integrated movement in textile forms, independent of traditional electronics. These breakthroughs herald a future of textile art that is self-powered, sensorially responsive, and deeply embodied—able to dynamically unfold movement, light, or transformation without visible wiring or power sources.

Conclusion

The convergence of electronics and textiles represents a transformative moment in both design and artistic practice. What began as experimental applications of conductive threads and simple circuits has grown into a field that now encompasses woven and printed electronic fabrics, fiber-level computing, and fully integrated smart systems. These advances have enabled textiles to move beyond their traditional roles as functional and decorative materials, becoming interactive, responsive, and even adaptive media. From healthcare monitoring and wearable interfaces to expressive art installations and interactive garments, electronic textiles illustrate the profound potential of merging material innovation with digital technology.

In the context of art, electronic textiles expand the expressive vocabulary of textile practitioners by enabling works that change color, emit light, respond to touch, or visualize data. Artists and designers are increasingly embracing these technologies not only to enhance aesthetics but also to engage audiences in new forms of sensory and participatory experience. As sustainability, durability, and washability challenges are addressed through advances in materials science and standardization, electronic textiles will continue to mature as both a functional technology and an artistic medium.

Ultimately, electronic textiles exemplify the interdisciplinary collaboration between engineering, design, and art. Their evolution reflects a growing cultural interest in interactive, embodied, and adaptive forms of creativity. Looking forward, the integration of energy harvesting, artificial intelligence, and biodegradable conductive materials will shape the next generation of smart textiles—garments and artworks that are self-sustaining, environmentally conscious, and deeply interactive. In doing so, electronic textiles not only redefine the future of design and wearable systems but also reimagine the possibilities of textile art in the digital age.

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Author Contributions

The author contributed equally to the conceptualization of the article and writing of the original and subsequent drafts.

Data Availability Statement

Not applicable

Acknowledgements

Not applicable

Conflict of interest

The author declare no conflict of interest.

References

Buechley, L., Eisenberg, M., Catchen, J., & Crockett, A. (2008). *The LilyPad Arduino: using computational textiles to investigate engagement, aesthetics, and diversity in computer science education* Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, Florence, Italy. https://doi.org/10.1145/1357054.1357123

Farraj, Y., Kanner, A., & Magdassi, S. (2023). E-Textile by Printing an All-through Penetrating Copper Complex Ink. *ACS Applied Materials & Interfaces*, *15*(17), 21651-21658. https://doi.org/10.1021/acsami.3c02242

Gopalsamy, C., Park, S., Rajamanickam, R., & Jayaraman, S. (1999). The Wearable Motherboard™: The first generation of adaptive and responsive textile structures (ARTS) for medical applications. *Virtual Reality*, *4*(3), 152-168. https://doi.org/10.1007/bf01418152

Hughes-Riley, T., Dias, T., & Cork, C. (2018). A Historical Review of the Development of Electronic Textiles. *Fibers*, *6*(2).

Karim, N., Afroj, S., Malandraki, A., Butterworth, S., Beach, C., Rigout, M., Novoselov, K. S., Casson, A. J., & Yeates, S. G. (2017). All inkjet-printed graphene-based conductive patterns for wearable e-textile applications [10.1039/C7TC03669H]. *Journal of Materials Chemistry C*, *5*(44), 11640-11648. https://doi.org/10.1039/c7tc03669h

Loke, G., Khudiyev, T., Wang, B., Fu, S., Payra, S., Shaoul, Y., Fung, J., Chatziveroglou, I., Chou, P.-W., Chinn, I., Yan, W., Gitelson-Kahn, A., Joannopoulos, J., & Fink, Y. (2021). Digital electronics in fibres enable fabric-based machine-learning inference. *Nature Communications*, *12*(1), 3317. https://doi.org/10.1038/s41467-021-23628-5

Ojstršek, A., Plohl, O., Gorgieva, S., Kurečič, M., Jančič, U., Hribernik, S., & Fakin, D. (2021). Metallisation of Textiles and Protection of Conductive Layers: An Overview of Application Techniques. *Sensors*, *21*(10).

Onggar, T., Kruppke, I., & Cherif, C. (2020). Techniques and Processes for the Realization of Electrically Conducting Textile Materials from Intrinsically Conducting Polymers and Their Application Potential. *Polymers*, *12*(12).

Rotzler, S., Krshiwoblozki, M. v., & Schneider-Ramelow, M. (2021). Washability of e-textiles: current testing practices and the need for standardization. *Textile Research Journal*, *91*(19-20), 2401-2417. https://doi.org/10.1177/0040517521996727

Ruckdashel, R. R., Khadse, N., & Park, J. H. (2022). Smart E-Textiles: Overview of Components and Outlook. *Sensors*, *22*(16).

Sajovic, I., Kert, M., & Boh Podgornik, B. (2023). Smart Textiles: A Review and Bibliometric Mapping. *Applied Sciences*, *13*(18).

Tadesse, M. G., Abate, M. T., Felix Lübben, J., & Rauch, M. (2025). Recycling and Sustainable Design for Smart Textiles − A Review. *Advanced Sustainable Systems*, *n/a*(n/a), 2401072. https://doi.org/https://doi.org/10.1002/adsu.202401072

Tseghai, G. B., Malengier, B., Fante, K. A., Nigusse, A. B., & Van Langenhove, L. (2020). Integration of Conductive Materials with Textile Structures, an Overview. *Sensors*, *20*(23).

Wang, Y., Sun, C., & Ahmed, D. (2025). A smart acoustic textile for health monitoring. *Nature Electronics*, *8*(6), 485-495. https://doi.org/10.1038/s41928-025-01386-2

Zhang, J., Ye, S., Liu, H., Chen, X., Chen, X., Li, B., Tang, W., Meng, Q., Ding, P., Tian, H., Li, X., Zhang, Y., Xu, P., & Shao, J. (2020). 3D printed piezoelectric BNNTs nanocomposites with tunable interface and microarchitectures for self-powered conformal sensors. *Nano Energy*, *77*, 105300. https://doi.org/https://doi.org/10.1016/j.nanoen.2020.105300

Zohoori, S., Latifi, M., Davodiroknabadi, A., & Mirjalili, M. (2017). Vibration electrospinning of Polyamide-66/Multiwall Carbon Nanotube Nanocomposite: Introducing electrically conductive, ultraviolet blocking and antibacterial properties. *Polish Journal of Chemical Technology*, *19*. https://doi.org/10.1515/pjct-2017-0049

Zysset, C., Cherenack, K., Kinkeldei, T., & Tröster, G. (2010, 10-13 Oct. 2010). Weaving integrated circuits into textiles. International Symposium on Wearable Computers (ISWC) 2010,