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The Impact of Artificial Intelligence on the Integrity of Stylistic Properties in Historic Buildings: An Analysis of Architectural Model Levels

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Abstract

Historical buildings play a pivotal role in enhancing architectural identity through their stylistic characteristics. They offer a unique set of architectural elements that enhance the value of the city and give it a distinctive character. With technological developments, artificial intelligence has emerged as an effective tool for dealing with historical buildings in general. However, the influence of AI tools on the Integrity of architectural model levels at which stylistic characteristics are manifested has not yet been proven. Hence the research problem appeared as (lack of clarity regarding the impact of artificial intelligence technologies on architectural model levels reflecting stylistic characteristics and ensuring the integrity of historical buildings). From here, the research goal took shape as (determining the impact of artificial intelligence technologies and tools on the Integrity of levels reflecting the stylistic characteristics of historical buildings). The importance of this research lies in providing a framework for the capabilities that artificial intelligence provides in historical buildings, at the level of documentation and development. It has been found that artificial intelligence tools such as ideogram are most effective in ensuring the integrity of The Associated stylistic characteristics (color/proportions/decorative features/material). They enhance the integrity of stylistic characteristics at their formal levels by being able to accurately monitor and diagnose structural problems of the building, which allows taking the necessary preventive measures. AI tools at the formal level have proven to be more effective than at the functional and aesthetic levels. The study recommends careful selection of AI tools to ensure their Integrity at the level of documentation and development.

1.0 INTRODUCTION

The preservation of historical buildings is a fundamental pillar for the permanence of cultural heritage because these buildings represent an important identity at the historical and social level for all societies, and after the technological development to the emergence of its latest technologies represented by artificial intelligence, which revolutionized the field of architectural heritage preservation because it provided high-level innovative possibilities contributed to the evaluation and restoration of historical monuments in a more accurate and effective way . A feature of artificial intelligence is that it is able to improve the ability to digitize and analyze buildings, which contributes to constant assessments of the state of historical buildings conducted by specialists without relying on physical interventions that could damage them .Machine learning and deep learning technologies help to analyze historical buildings through the huge data they possess, whether in the form of three-dimensional models, environmental data such as temperature or humidity, or in the form of photographs, which facilitates the process of identifying damage patterns and detecting possible structural problems over time. Such models are able to build accurate proactive analyzes of the future state of historical buildings, allowing to carry out preventive interventions, if necessary, in a timely manner. This technique shows great potential in the restoration of lost or deteriorated elements in buildings. Artificial intelligence, with its ability to analyze intact parts or historical data, can be used to recreate damaged parts with high accuracy. These techniques were also able to simulate historical designs and original materials of historical buildings, which supports the process of preserving stylistic characteristics to determine what an architectural model is if the interpretation of the architectural model is tied to a fixed formula determined by the stylistic characteristic of a particular time or place. Despite the benefits that artificial intelligence provides, there are technical and ethical difficulties and challenges associated with the application of these technologies. The results of artificial intelligence mainly depend on the volume of data on which it is trained and the accuracy, bias or inaccuracy of these data, which negatively affects the accuracy of these results. In addition, the role of human experience in making sensitive decisions that ensure the process of preserving the architectural originality of historical buildings and their value should be emphasized .Artificial intelligence also has the ability to improve and accelerate the preservation of the stylistic characteristics of historical buildings and their integrity as part of its effective technologies of restoration, digitization and continuous assessment of the condition of historical buildings, which, in turn, contributes to more accurate and effective preservation of this heritage for future generations(Gaber et al., 2023)

However, the impact of AI technologies on architectural model levels is unclear and how they reflect stylistic characteristics and ensure the Integrity of historical buildings. So architectural integrity is a holistic concept that has multiple interpretations, including aspects such as damage prevention, protection, preservation and repair of damage. This concept requires special attention in the field of architecture to ensure the continuity of historical buildings and protect them from deterioration, so the research aims to determine the impact of artificial intelligence technologies and tools on the integrity of levels that reflect the stylistic characteristics of historical buildings.

2.0 METHODOLOGY

The research adopted a two-pronged approach. The first focused on clarifying historical buildings, their connotations, and their stylistic characteristics, concluding with the identification of the levels that express stylistic characteristics in historical buildings, including (the formal, organizational, and aesthetic levels). The technology and integrity of stylistic characteristics in historical buildings were also clarified. The theoretical aspect was then determined by addressing artificial intelligence tools and their importance within historical buildings. Design integrity strategies (restoration and preservation) were also addressed using artificial intelligence tools and their role at the (formal/spatial organization/aesthetic) levels as shown in Fig. 1). The other aspect included the practical study of selecting three artificial intelligence tools (chat GPT, Adobe Firefly, Ideogram, and Midjourney) to generate architectural images. A questionnaire was then created for specialists to measure and determine the accuracy of the most influential tools in achieving the integrity of the stylistic characteristics of the historical building, both formal and aesthetic.

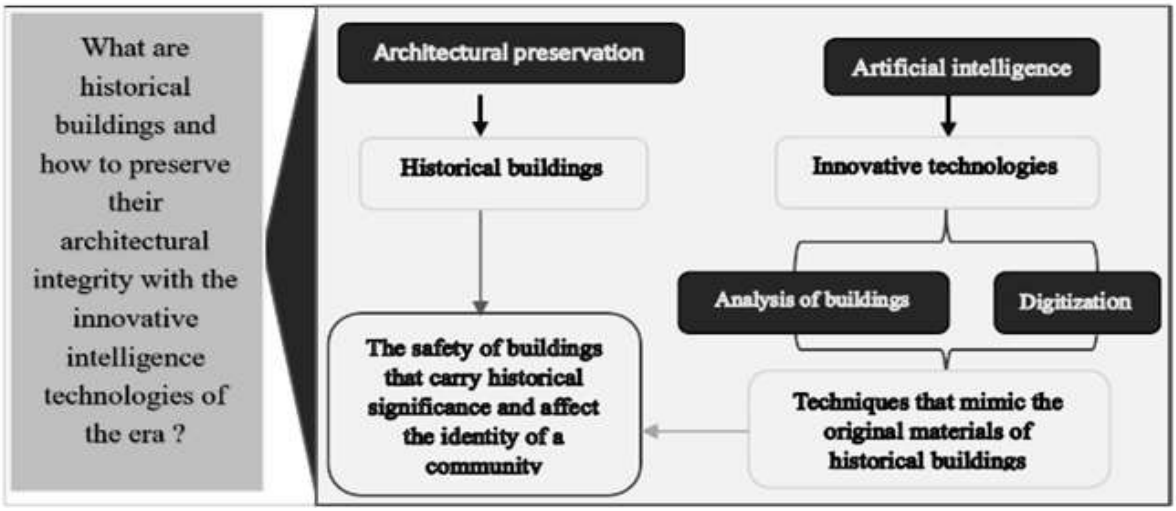

Figure 1. Demonstrates the centrifugal relationship between artificial intelligence and architectural conservation.

2.1 Historical buildings and their significance

These are buildings that collectively constitute the architectural heritage of a region, carrying in their content historical value through their architectural and aesthetic formation and their temporal extension, or by the important religious, economic, social or political event associated with them related to the possibility of the period in which they were created. (Atama, 2007) To give the spirituality of the place a desire to explore it, the underlying reason of its construction, what it carries in its being and its formative image of what it has produced from its culture. (Al-Hanish & Al-Rumaih, 2017; Majidi & Harith, 2015)

The historical buildings embody a material and cultural architectural heritage that influences the identity of nations. (Al-Nimra, 2014) these buildings contribute to the formation of the identity and distinctive character of cities and serve as prominent landmarks reflecting the architectural style and local culture.(Tychola et al., 2023) .That is, they play a pivotal role in preserving the cultural identity and cultural heritage of communities because their existence provides valuable information about construction techniques, material properties and historical events in the period of their creation.(Erdemir & Başar, 2019)

Therefore, historical buildings are an important source for understanding the development of architecture and design through time, as they are a witness to the extent of the development of methods, materials and techniques used through the ages.

In addition, historical buildings are a unique system of architectural elements and decorative details that enhance the spatial value of the place of their construction to add a distinctive character that falls under the category of buildings of value that must be preserved for future generations and that preservation is done through protection and restoration, where the restoration process includes preserving the original elements of the building and reuse in a manner consistent with the requirements of the era without affecting its historical character.(Tawfiq, 2022)

Historical buildings also play a role in stimulating the economic development of the surrounding areas to become a center for attracting tourists and visitors, which in turn leads to the growth of local businesses to boost the country's economy.(Anisa & Lissimia, 2020) However, the process of preserving the integrity of historical buildings faces great challenges that lead the world to explore innovative technologies for restoration and maintenance, during the current period, intelligence is a powerful tool in conservation and restoration efforts because its technologies enhance the accuracy and efficiency of conservation practices.(Abidah, 2023)

According to the recent experiments conducted using artificial intelligence technologies, represented by digital reconstruction through the use of three-dimensional point cloud and competitive generation networks, experts have reached promising results in the restoration of buildings with high accuracy, where the error rate in the restoration of various types of historical buildings was between 0.09 and 0.17. (Fang, Hui, Rey, Yang, & Liu, 2024).

Therefore, the above shows the extent of the possibility of artificial intelligence techniques in preserving the integrity of historical buildings, but no comprehensive studies are showing the extent of the impact of intelligence techniques in the preservation process, especially regarding stylistic characteristics. As a result, questions arise, including what the stylistic properties are and how can the stylistic properties of historical buildings be preserved and intact.

2.2 Stylistic characteristics of historical buildings

He interpreted the style as having a fixed formula resulting from the repetition of the formal properties of the architectural subject associated with a particular person, group of people, time or place.(Persinger, 2007) It represents "the fixed forms and sometimes the fixed elements, qualities and expressions in the art of an individual or a group of individuals".(Abowd et al., 1995) The focus on properties is evident in determining what a model is.

The focus on the style or method of construction was the second aspect associated with the interpretation of the model as a fixed formula determined by properties. It is defined as "a particular method of construction, the fixed characteristics characteristic of a specific time, a specific place, a person or an artistic movement". The emphasis on the importance of the formal properties and the style of execution in the interpretation of the style has been strengthened by several types defined by a set of characteristics and distinctive features of the construction style and its assembly or related to the appearance of the outer shell.(Dictionaries, n.d.)

The model interprets and distinguishes by observing repetitive elements, repeating their qualities and expressions, or repeating the system. Since " the duplicate properties are responsible for highlighting the identity of the model system, which once changed, this system no longer exists.

A model is interpreted based on its relation to "formal properties, execution style, or components", it represents a comprehensive system. The levels of this system included, among other things, other components. The stylistic system in the artistic and architectural work included three levels, namely:

- The level of the world of thoughts and feelings (intellectual)World of thoughts and feelings.
- The level of the plastic world (Aesthetic) Plastic world.
- The level of the world of reality (physical) World of Visible Reality.

These levels were reinforced by the interpretation of the model system as having two existences related to "the pattern, which represents an invisible intellectual existence represented by the pattern. And the presence of a visible physicist represents the physical embodiment of the idea of style.(Z. Al-Obaidi, 2016) The model system consists of two levels, represented by the " pattern or intellectual structure, the model that includes the components according to which thought is transformed into a physical embodiment.

As for the moral level, the model was interpreted as having a variable form through its connection with the meaning derived from the interpretation of the model as a means of expression. The model represents "the total meaning of the physical form that we obtain from the presence of fixed elements and features in individual or collective action.(Hoppenbrouwers et al., 2005; Sherblom, 2015)

A style represents a pattern, a style, a way of expressing, or several ways of turning thoughts into words; (Burchfield, 1963) It also represents "a means of expressing spiritual, civilizational and human values, it is a language capable of evolution and adaptation to time".(Abowd et al., 1995) The moral level is formed through its interpretation in connection with expressive means that focus on cognitive meaning. The stylistic characteristics of historical buildings are related to (the level of general and decorative detail/the general character of the historical building includes what defines the formal historical identity in terms of materials and texture /geometric and architectural proportions /light and shadow treatments).

It turns out that the levels within which the stylistic properties are reflected can be limited to (the formal level and its associated properties of the formal body associated with the principles of the elements in terms of proportions, repetition, color, texture, light and shadow treatments /spatial level/detailed level associated with decorative details) as shown in Table 1.

Table 1. Shows the levels within which the stylistic characteristics of historical buildings stand out

Levels within which the stylistic characteristics of historical buildings stand out		
A formal level related to the properties of the formal body	Material and texture	
	Geometric proportions	
	Colour	
	Principles governing the rules of composition	Symmetrical iteration
		Different iteration
	General manipulations at the light and shadow level	
A spatial level related to the nature of spatial organization	Components	
	Relations between the organization	
Aesthetic level of detail	Decorative details	
	Structural decorative details	

2.3 Technology and Integrity of historical buildings stylistic characteristics of historical buildings

The Integrity of historical buildings is crystallized in (protecting them from deterioration and damage, preventing damage caused by negligence by preserving the original function of the building, preserving the historical identity associated with its detailed character), and providing complete Integrity of the historical building is a basic requirement in restoration operations, as the restoration process is based on basic considerations including architectural design and aesthetic form of the building, and this is different from the restoration of traditional buildings. The restoration of historical buildings requires taking into account the function of the building and the loads to which it is subjected, as well as its location, installation and physical nature. The challenges in the field of restoration include achieving a balance between the complete Integrity of the building and the cost of restoration, in addition to the use of modern materials commensurate with the basic form of impact and the impact of damage and time factors on the building materials.(M. Abdullah et al., 1991) because the process of restoring the building to its original state includes multiple stages such as Cadastral and architectural monitoring, analysis of factors threatening the integrity of the building, and the compilation of historical documents, a process that may include an individual building, a group of buildings, or even an entire city. (Al-Sharbeni & Mahmoud, 2004)

In order to protect historic buildings from deterioration and damage, traditional and modern strategies have been adopted aimed at preserving their aesthetic, structural and functional integrity. Traditional strategies also include architectural reconstruction and restoration, where the original construction is simulated using the same materials and old construction methods to ensure the restoration of the traditional form. Also, cross-stitching is reinforced either mechanically using anti-corrosion steel beams to repair cracks, or chemically through adhesives that match the original materials. Other methods include injecting walls to fill voids and reattaching the internal filler to ensure durability, as well as disassembly and reassembly, which is based on dismantling and reinstalling damaged elements. Modern strategies include back-bracing to strengthen decorative ceilings and walls, and rebalancing of buildings that suffer from tilt using advanced techniques such as."Total Station".

It also includes recombination by casting to create replicas of damaged items with the aim of restoration, cleaning and removing coatings to preserve the original materials and prevent deterioration. That is, the main goal of these strategies is to ensure structural integrity with the stability of the building and its ability to withstand loads, and functional Integrity while maintaining the original function of the building, in addition to aesthetic Integrity through the preservation of decorations and historical monuments. (Anwar, 2019)

It turns out that technology and artificial intelligence have a role in the Integrity of historical buildings, and this was not explicitly clear, which led to the emergence of the research problem represented by (lack of perception of AI technologies and their role in the Integrity of the stylistic properties of historic buildings). The research aims to define a framework for the role of artificial intelligence in the integrity of the stylistic properties of historical buildings. The study adopted a methodology that included two aspects, the first specialized in the statement of artificial intelligence, its tools, importance and techniques employed in historical buildings, and the second side specialized in the practical study, which included examining the

impact of artificial intelligence tools on the integrity of the model properties of a local sample represented by the Mustansiriya school.

3.0 THEORETICAL ASPECT

3.1 Artificial Intelligence Tools

Generative design tools have emerged as the most prominent developments of artificial intelligence tools in the field of architecture, which rely on algorithms that contribute to exploring the possibilities of various designs, enabling engineers to build projects with high performance and accuracy, as this ability is important for the development of design solutions with sustainability and high efficiency. The research focuses light on the importance of using generative artificial intelligence for multimedia with visual and textual inputs.

This integration, which combines visual and textual inputs, enhances creativity in design processes, allowing specialized engineers to create more creative and diverse design methods and options , in addition, tools such as mid-journey, ideogram, DALE, Adobe Firefly and Stable Diffusion are examples of artificial intelligence programs and platforms that generate images from text and modify and add to images .These tools are highly capable and effective in creating architectural visualizations, including creating visualizations, simulating heritage and historical sites and representing them. Because it allows engineers to quickly visualize concepts and explore different aesthetic directions. (Fitriawijaya & Jeng, 2024)

Generative AI models such as Adobe Firefly enhance creativity on a practical level by integrating it into production and design applications such as Photoshop, Premiere Pro, and Illustrator, and in turn simplify creative and design processes through the use of key features such as text-to-image conversion, pattern transfer, and generative packaging. These technologies provide huge possibilities in designing, editing and optimizing images, contributing to improved productivity and quality.

Adobe Firefly also represents a qualitative development in generative artificial intelligence technologies. This model is characterized by significant improvements in realistic image quality, fine detail, and creative versatility. This model also provides smart tools for understanding complex and long text descriptions, allowing creators to produce images with great clarity and accuracy while increasing efficiency and speed of the production process .As for the Ideogram model , it is very adept at producing realistic high-resolution images, and it is one of the advanced artificial intelligence tools that closely corresponds to the user's needs .The features of this program allow controlling the platform by customizing it to make adjustments to the resolution and quality of images, as well as aspect ratios, and we can briefly say that Ideogram, especially the paid version, offers a remarkable and significant development, as it offers innovative features that respond to various creative work requirements .It is considered an equally valuable tool for its ability to integrate readable texts into images, in addition to various artistic styles, as well as customization options .

In addition, the process of inserting an image as a reference in the Midjourney program and using it to create new images gives great flexibility in the process of maintaining the consistency of styles or changes to visual elements. This creates the possibility for users not only to generate static images but also dynamic and interactive content. As a result, these have great potential to generate detailed historical and heritage images, but they face serious challenges in preserving historical authenticity, especially in restoration tasks where traditional methods, accurate data sets and mixed workflows often outperform purely generative or text-to-image conversion approaches.

That is, these programs allow a detailed and visually stylized reconstruction of useful textual descriptions of conceptual representations and stimulate cultural perception.

3.2 The Importance of Artificial Intelligence in Historical Buildings

Artificial intelligence is a field that seeks to develop computer systems capable of performing tasks that normally require human intelligence such as visual perception, speech recognition, decision-making, and language translation. (Mehak et al., 2023) Artificial intelligence aims to enable these systems to simulate or outperform human mental processes. (Ola, 2023) Artificial intelligence technologies also include tools such as rule-based systems, genetic algorithms, artificial neural networks, and fuzzy models. (Chen et al., 2008) At the level of continuous development in the field of architectural design, artificial intelligence (AI) tools are increasingly being used, which leads to the creation of new and more creative ways of designing architectural projects. Some of the most used tools in this area are generative platforms such as Midjourney, DALL-E and stable Diffusion, which rely on artificial intelligence techniques to generate images from text and other visual

inputs. Midjourney is particularly distinguished in facilitating the architectural design process by enabling engineers to convert textual ideas and concepts into visual visualizations quickly and accurately, which contributes to speeding up the process of innovation and modification of designs. (Tan & Luhrs, 2024)

This method is based on divergent thinking which allows generating multiple ideas and solutions, and convergent thinking which focuses on improving and choosing the most appropriate among these solutions. This methodology enhances the ability of Engineers to better respond to the needs of users. In addition to architectural design, the capabilities of these tools extend to other areas such as architectural heritage and historical contexts, where these tools can generate visualizations of spaces and places that in reality did not yet exist.

This flexibility is a key element in expanding the range of possible applications of these tools.(Fitriawijaya & Jeng, 2024). The integration of generative AI into architectural design is a shift in how we approach the processes of creativity and design. These tools help engineers improve the efficiency of the design process and increase flexibility in exploring new ideas. Using Midjourney, architects can generate accurate and diverse architectural visualizations based on complex textual descriptions. AI-powered generative design is also characterized by its ability to provide sustainable and effective design solutions, which is necessary in the face of modern challenges that require the integration of creativity with effective performance. Among the exciting developments in this context, there is a growing interest in integrating artificial intelligence technologies with blockchain technology to ensure data ownership and provide greater security for collaborative processes between engineers and customers. This integration enhances the possibility of converting descriptive designs into non-replaceable codes (NFTs), ensuring traceability and protection of sensitive data. .(Fitriawijaya & Jeng, 2024)

By using machine learning algorithms to analyze data on the deterioration patterns of historical buildings, these algorithms contribute to predicting the deterioration of future structures based on environmental factors and the characteristics of the materials used, which helps in taking the necessary preventive measures to ensure their long-term stability. In addition to the adoption of digital twins that rely on artificial intelligence to continuously monitor structures, as was applied in the Notre Dame Cathedral after the fire to analyze the integrity of structures and provide accurate data to help in the restoration operations. Predictive maintenance technologies powered by artificial intelligence have also helped to monitor old structures, identify the need for repairs and reduce traditional checks. Three-dimensional modelling techniques are also currently being used to digitally reconstruct historical buildings and visualize the missing parts, providing an accurate view of the buildings and helping to restore the damaged parts accurately, as shown in Table 2. (Ghaith, 2024).

Table 2. Explains the importance of using intelligence tools and their role in preserving historical buildings.

Levels within which the stylistic characteristics of historical buildings stand out			
Intelligent tools that create images of heritage and its contexts	Promote divergent thinking	Image generating platforms such as Midjourney ، DALL-E ،Stable Diffusion	
	Promote convergent thinking	Choosing optimal solutions and optimizing them using artificial intelligence	
Intelligent tools that analyze Heritage Buildings Data	Machine learning algorithms for analyzing the deterioration patterns of historical buildings	Forecasting the deterioration of structures based on the properties of materials and environmental factors	
	Digital twins for monitoring structures	Continuous monitoring of historical structures	
	Three-dimensional modelling tools	Creating accurate digital models of buildings	Accurately reconstruct the missing parts
	Predictive maintenance tools	Analyze maintenance data to minimize unnecessary repairs	Reduce traditional checks and identify required repairs

3.3 The Importance of Artificial Intelligence in Historical Buildings

AI-based inspection methods have become fundamental in the preservation and monitoring of historical buildings (HB), where these methods, especially those using deep learning technologies, are adopted so that intelligence tools become effective tools for identifying and evaluating various types of damage and deterioration at the sites of historical buildings and verifying their integrity through:

- Detection of deterioration of roofs of historical buildings: Deep learning algorithms are used to detect surface damage in historic buildings, where these models analyze high-resolution images to identify defects such as cracks, flaking (surface fragmentation), discoloration, and biological growth. (Gaber et al., 2023) The stages of processing historical images using intelligence techniques begin with preparing images through specific processing techniques by reducing noise and smoothing the image, enhancing contrast and improving image details, increasing sharpness and clarifying the exact characteristics. These processors highlight key visual features, helping to improve recognition accuracy. Neural networks are then used to extract basic image properties such as lines, shapes, and colors, then convert the images into digital arrays that are analyzed to identify visual patterns accurately. The extracted images are then compared using distance scales, which contribute to determining the degree of similarity between the images based on their features. (Rangkuti et al., 2023).
- Incisions detection and facade damage assessment: AI models are designed to contribute to the preservation of both the structural integrity and the aesthetic value of historical buildings by providing status scores or detailed classifications of various types of damage. these AI tools facilitate timely repairs and help prioritize conservation efforts. The ability to systematically assess the condition of the facades also helps to preserve the visual and historical significance of the structures. It also helps to automatically identify incisions and their locations in both structural elements and non-structural components such as tiles to prevent structural damage. This early detection is also vital for planning appropriate corrective interventions, such as the application of epoxy resins to fill incisions and to prevent potential Integrity hazards. (Gaber et al., 2023).
- Detection of architectural elements and components: AI models are also used to identify and index key architectural elements and components within historical and cultural heritage buildings. This capability enhances digital documentation efforts by providing detailed records of building elements, which are useful in restoration projects and historical analysis. Accurate disclosure of architectural features supports a comprehensive assessment of the condition of the building and helps preserve its historical accuracy. (Gaber et al., 2023).

Artificial intelligence technologies are therefore vital tools in the preservation of historical buildings, as it enables the early detection of surface damage and cracks, facilitating the necessary repairs. Such techniques contribute to assessing the general condition of facades and architectural elements, enhancing their integrity and aesthetic value. It also addresses issues of degradation caused by environmental factors, helping to preserve the beauty and sustainability of historical structures. In total, these methods enhance documentation and conservation efforts, supporting the integrity of buildings and preserving their cultural heritage.

3.4 Design strategies (restoration and preservation) using artificial intelligence tools and their relationship to historical buildings

Restoration and preservation strategies for historic buildings require a careful balance between the interventions necessary to preserve the integrity of the original structure of the building while taking care to minimize the negative effects that may result from these interventions. Also, this balance is based on an in-depth understanding of the environmental and biological effects on the materials used in construction, as well as a thorough analysis of the factors that lead to the deterioration of structures without making radical changes to the original design. Among the tools used to assess the current state of historical buildings, techniques such as X-ray imaging and electron microscopy stand out, which provide detailed images of possible damage and help determine the type of deterioration and assess its severity.(Rangkuti et al., 2023)

An important aspect of restoration strategies is the control of biodegradation caused by organisms such as fungi, bacteria and algae, which contribute to the degradation of materials over time. To reduce these effects, bioremediation techniques and water repellents are used to keep surfaces dry, preventing the growth of these harmful organisms .(Rangkuti et al., 2023) to ensure the cohesion of the materials used in the restoration with

the original ones, the materials are selected according to their physical and chemical properties, with the aim of avoiding the occurrence of undesirable reactions leading to additional deterioration of the building. (AbdAlHadi, 2004)

Maintenance and restoration operations are not limited to repairing structures, but extend to returning buildings to their optimal state and enhancing their architectural and historical value. (El-Sherbini, 2004) Restoration requires sufficient evidence to restore the original condition of the buildings while respecting the site's cultural significance. (Prof. Dr. Y. Abdullah & Mohamed, 2000) Restoration is an art aimed at preserving the architectural heritage and rehabilitating damaged old buildings, taking care to preserve their structural structure, external and internal appearance. (Al-Safarini, 2009a)Restorations also rely heavily on careful research and excavation to ensure that the authenticity of the building is preserved without compromising its essence. (Hazar & Dabura, 1997), as shown in (Fig. 2).

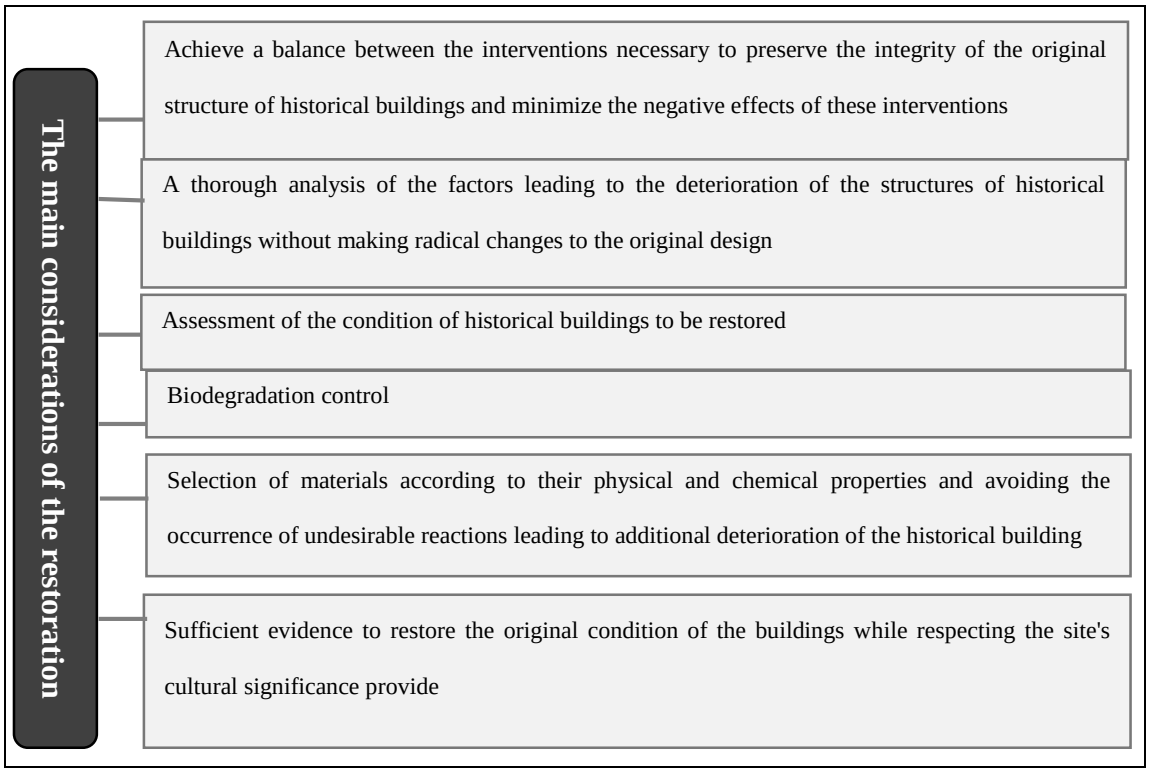

Figure 2. Shows the main considerations of the restoration strategy

The restoration of historical buildings using artificial intelligence (AI) is a modern and developing field, which relies heavily on computer vision (CV), deep learning (DL), and three-dimensional reconstruction technologies. These technologies rely on advanced tools such as three-dimensional point clouds and competitive generative networks (GANs) to produce accurate models of damaged buildings, enabling accurate restoration of the original structure. Point cloud technology relies on collecting detailed three-dimensional data from scanning devices and converting them into digital models that include precise geometry and surface texture, enabling more accurate restoration using artificial intelligence algorithms.

Competitive generative networks play an essential role in this process, the generator produces possible restoration models based on the entered data, while the discriminator distinguishes between the generated results and the original data to ensure the accuracy of the restoration. These techniques are also superior to traditional methods in efficiency and accuracy, as loss functions such as the chamfer distance (CD) and the ground drive distance (EMD) are used to assess the conformity of the restored model with the original, ensuring the preservation of structural details. The integration of the three-dimensional point cloud and GANs enables accurate and rapid restoration of historical buildings, contributing to the efficient preservation of cultural heritage in the digital age.(Fang, Hui, Rey, Yang, Liu, et al., 2024).

It turns out that the strategy of restoration and rehabilitation with artificial intelligence focused on levels within which the stylistic characteristics of historical buildings are highlighted, which relate to (formal/ aesthetic level).

3.4.1 Artificial Intelligence Within the Formal Level

The structural basis includes assessment and examination practices for the condition of the structure and materials, and these practices rely on accurate and comprehensive assessments of the condition of the building, including material analysis, structural assessment, and detailed historical documentation. (Pagliuca & Guida, 2016) Among the technologies used, the use of modern technology such as ground-penetrating radar (GPR) stands out in the assessment and inspection of structures without damaging them, which allows us to identify hidden problems and plan restoration interventions more accurately.(Barone et al., 2010) innovative restoration technologies such as the use of composite materials and Basalt fibres are also employed in strengthening and strengthening structural elements, providing effective and durable solutions while preserving the aesthetic appearance and historical authenticity of buildings .(Pagliuca & Guida, 2016)

In addition, digital documentation and structural information modelling (BIM) technologies contribute to documenting and planning restoration operations more efficiently and accurately, facilitating project management and monitoring their progress. (Fitriawijaya & Jeng, 2024) despite these developments, current practices face some weaknesses, among which excessive reliance on modern technologies without sufficient consideration for traditional techniques and crafts, which may lead to the loss of some authentic aspects of historical buildings.(Li et al., 2024) The application of modern technologies can also be expensive and requires specialized resources and expertise that may not always be available, especially in areas with limited resources .(Al-Safarini, 2009b)

In addition, the lack of coordination and effective communication between stakeholders and stakeholders may lead to the implementation of restoration projects that do not comply with optimal standards for Heritage Preservation, which negatively affects the integrity and authenticity of historical buildings.(Ghaith, 2024) to improve the effectiveness of current practices, it is necessary to adopt an integrative approach combining traditional and modern technologies, while strengthening the training and capacity-building of specialists in the field of restoration, providing adequate financial and institutional support to ensure the implementation of sustainable and effective restoration projects that preserve cultural heritage for future generations. (Roca, 2011)

3.4.2 Artificial Intelligence Within the Aesthetic Level

Artificial intelligence plays a vital role in maintaining the aesthetic integrity of historical buildings by detecting and treating surface defects in an accurate and non-intrusive manner. For example, a study conducted on gulang Island, a UNESCO registered World Heritage site, showed that AI models such as Swin Transformers achieved high accuracy in detecting and fragmenting defects while minimizing the percentage of human error, preserving the original design of buildings and preventing aesthetic deterioration. (Fu & Angkawisittpan, 2024)

Techniques such as YOLO are also used in the study of archaeological monuments in India to detect surface defects and damage to decorations, which allows accurate and continuous monitoring of the aesthetic condition of buildings and the compilation of detailed data used to plan maintenance and restoration operations effectively and in a timely manner. In addition, mobile phone sensing technologies and infrared thermal imaging are being applied to detect defects that are invisible to the naked eye such as damage to wooden decorations or changes due to environmental factors. Laser scanning technologies also provide three-dimensional models of buildings, which enable detailed analysis, accurate preservation of aesthetic elements and ensuring that they are not deformed during restoration.

Intelligent technologies based on artificial intelligence not only automate the process of detecting defects but also improve the quality of restoration by ensuring the preservation of fine details such as patterns, textures, and material combinations. These applications also contribute to reducing the risks to human inspectors by automating inspections in hard-to-reach areas such as roofs and facades, ensuring the preservation of visual elements without compromising the Integrity of workers. Thanks to these capabilities, specialists can make proactive decisions in preserving the aesthetic aspects of historical buildings, based on comprehensive information about the condition of these buildings and prioritize restoration based on aesthetic deterioration and not just structural damage, which enhances the long-term durability of their attractiveness and Integrity. (Mishra & Lourenço, 2024, p. 539).

Table 3. Explains the importance of using intelligence tools and their role in preserving historical buildings

Artificial intelligence and its effects at levels that highlight the stylistic properties of historical buildings			
Explanations of artificial intelligence	Visual interpretation		
	Data-driven interpretation		
	Context-based interpretation		
The goals of employing artificial intelligence in historical buildings	Generating multiple ideas and solutions		
	Optimize and choose the most suitable among the solutions		
	Protection from deterioration and damage		
	Prevention of damage caused by negligence		
	Preservation of historical identity		
Artificial intelligence tools	Midjourney		
	DALL-E		
	Stable Diffusion		
	Adobe Firefly		
	Ideogram		
Artificial intelligence interventions within the levels of modularity of historical buildings	Formal level	Observation phase	Analysis of data on the patterns of deterioration of historical buildings
			Continuously monitor structures
			Monitoring of old structures
		Principles governing the relationships between formal elements	Redundancy
			Proportionality and scale
			Rhythm
			Unity
			Domination
			Variation
		Properties of the morphological form	Color
			Texture
			Material
			Light and shadow treatments
The importance of artificial intelligence tools in historical buildings	Prediction	Deterioration of future structures based on environmental factors and the characteristics of the materials used	
		Analyze the Integrity of structures and determine the need for repairs	
		Reduce traditional check-ups	
	Documentation	Providing accurate data that helps in restoration operations	
		Visualize missing parts to accurately restore damaged parts	
		Digitally reconstruct historical buildings	

3.5 The Practical Aspect

The study relied on a descriptive-analytical approach to the research and analysis of artificial intelligence applications in improving historical images. The effects have been studied using advanced analysis tools including Chat GPT, Adobe Firefly, Ideogram, and midjourney. A questionnaire has been designed for specialists to measure the accuracy and effectiveness of enhanced images in simulating the decorative and architectural details of historical buildings.

3.5.1 Case Study-Al-Mustansiriya School in Baghdad \ Iraq

A historic building built in Baghdad, Iraq, which was erected by the Abbasid caliph Al-Mustansir Allah. The scientific importance that the school plays as one of the oldest universities in the world and its active role in the current society in the region, all this makes it the focus of attention of foreign and local tourists alike, and as a result it is an important cultural destination, which likes to be placed in the center of lights again and

preserved. In addition, the nature of the stylistic characteristics of the Mustansiriya school is an Islamic architectural style.(Al-Qaisi, 2003)

One of its advantages is its construction with high-quality yellow bricks, made in different shapes and sizes, varying depending on their use. It was used in the construction of cylindrical columns and various other supports. The building is characterized by the absence of covering the surfaces of the walls with any paint, decorated with natural ornaments (an ornament of ornaments at the brick level), which is an architectural feature of the Masons of the Abbasid era.(H. A. A. Al-Obaidi & Al-Tameemi, 2019) The nature of the decorations is represented by geometric decorative elements interspersed with vegetation, while at the top of the walls from the outside there is a decorative strip of writings explaining who built it and who repaired it with decorative elements interspersed with it .(Akram, 2019)

3.5.2 Practical Application Steps

First, preliminary analysis using Chat GPT set as follows:

- A photo of a historical building was entered using Chat GPT for a comprehensive architectural description.
- The analysis included detailed descriptions of the facades, arches, and decorations.

The result of the analysis was Generate a detailed and accurate description reflecting the elements of Islamic architecture, which provides a basis for image improvements in the following steps, as shown in (Fig. 3).

Figure 3. Realistic historical building photo.

Second, improve the image using Adobe Firefly:

Inserting the original image into Adobe Firefly with the settings set as follows:

- Aspect ratio 1: 1.
- For the lighting effect, choose "Warm Tone" settings to highlight colors.
- Intensify visual accuracy: choose "Visual intensity" to achieve the best possible results ,as shown in (Fig. 4).

Figure 4. The image of the historic building in the Adobe Firefly program.

Third, Using Ideogram to enhance the image and produce fine details set as follows:

- Enter the image into Ideogram and activate the "Magic Prompt" settings for accurate analysis.
- Apply the "Turbo" and "Image Weight" settings for accurate architectural details ,as shown in (Fig. 5).

Figure 5. The image of the historical building in the Ideogram program.

Fourth, Using Midjourney via Discord to generate enhanced images set as follows:

- Use Midjourney via Discord to upload and optimize photos using the "/imagine "command, as shown in (Fig. 6).

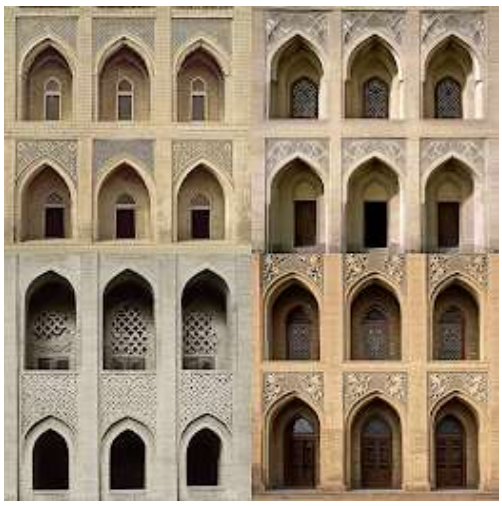

Figure 6. Photo of the historic building in the Midjourney program.

3.5.3 Design and Distribution of the Questionnaire

A questionnaire using Google Forms was designed to evaluate the quality of improved images by using intelligence programs from the point of view of experts in the fields of architecture and restoration. The questionnaire focused on the following elements:

- How close the photos are to the original.
- Evaluate the texture and colors.
- How well the photos retain the original details.

3.5.4 Analysis of the Results of the Questionnaire

- Target sample: the questionnaires included 34 participants from experts in the fields of architecture and restoration.
- Survey results as shown in Table :4

Table 4. Explains What did the questionnaire focus on.

What did the questionnaire focus on	The impact of using intelligence programs			
The question	Ideogram	Adobe Firefly	Midjourney	No effect
Accuracy of decorative details	% 64.7	%35.3	-	-
Realistic material and texture	%47.1	%44.1	%5.9	%2.9
Engineering and architectural accuracy	%47.1	%41.2	%5.8	%5.9
Preservation of historical character	%55.9	%23.5	%11.8	%8.8
Lighting and shadows	%50	%35.3	%5.9	%8.8
Preservation of fine details	%47.1	%44.1	%2.9	%5.9
The best result for digital documentation	%54.5	%33.3	%6.1	%6.1
The level of interference of artificial intelligence tools on model characteristics	Maintaining the integrity of the model with a few minor changes	Level Maintaining the integrity of the model	There are significant changes in the level of Model Integrity	-
	%85.3	%14.7	-	

3.5.5 Discussion of the Results of the Questionnaire

The results of the survey demonstrate the fundamental differences between AI models in their ability to simulate and analyze historical images. In addition, the analysis focuses on basic criteria including accuracy of decorative details, realism of materials and texture, geometric and architectural accuracy, preservation of historical character, lighting and shadows, preservation of fine details, the best result of digital documentation, the level of interference artificial intelligence tools on the stylistic characteristics. The results of the analysis reveal the features of each model and areas of improvement, according to the following details.

3.6 Accuracy of Decorative Details

The results showed the superiority of the Ideogram model by 64.7%, which indicates its high efficiency in representing accurate and complex decorative inscriptions. This superiority reflects the ability of the model to analyze and realize fine details that reflect the historical identity of buildings. Adobe Firefly achieved a lower percentage of 35.3%, which indicates its limited capabilities in rendering decorations with the same accuracy. On the other hand, Midjourney's performance was poor and unremarkable in this aspect, which confirms its need to improve the mechanisms for processing fine details,as shown in (Fig. 7).

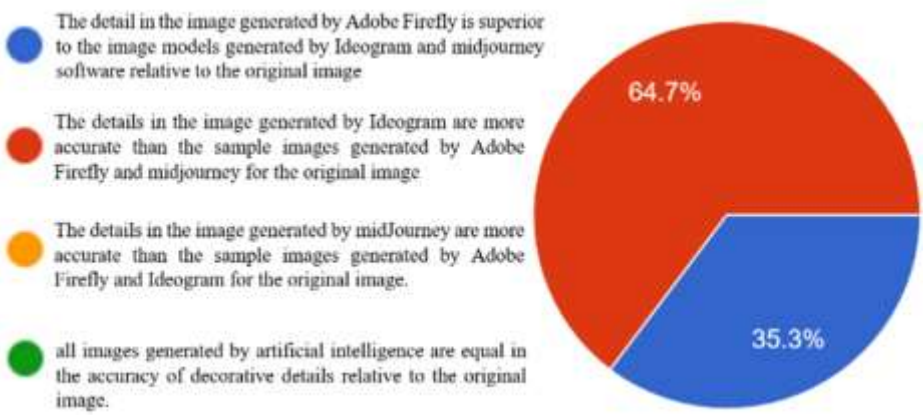

Figure 7. A form showing the questionnaire result for vocabulary (Accuracy of decorative details).

3.7 Realistic Material and Texture

The Ideogram model scored 47.1%, which makes it more efficient in simulating materials and textures closer to reality, while Adobe Firefly showed a similar performance of 44.1%. These proportions demonstrate the closeness of the two models in presenting materials that reflect the original character of the historic building. However, Midjourney performed poorly, scoring only 5.9%, highlighting a weakness in simulating realistic textures and textures of materials, a vital aspect in simulating architectural heritage. as shown in (Fig. 8).

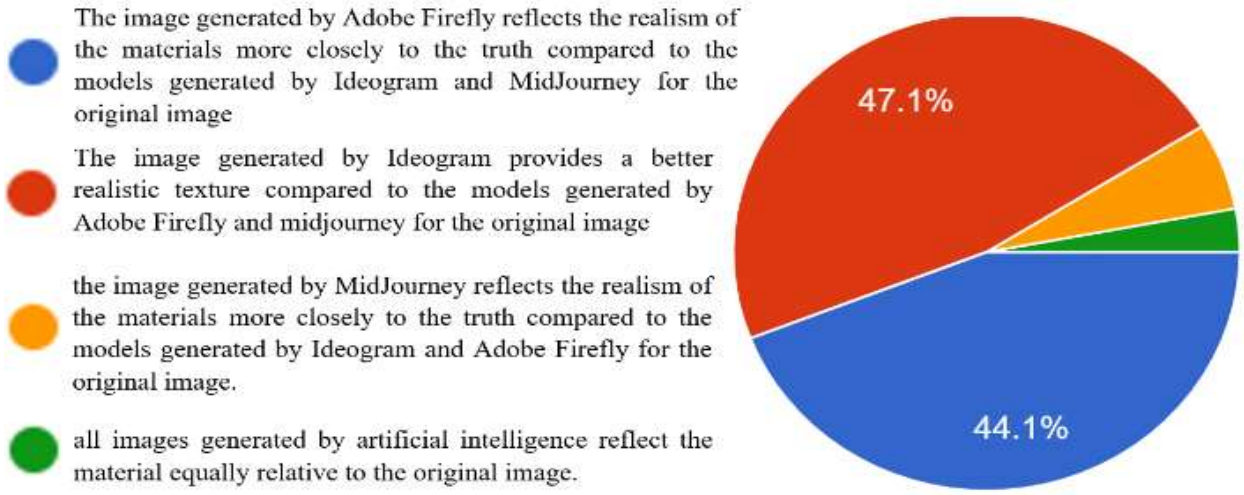

Figure 8. A form showing the questionnaire result for vocabulary (Realistic material and texture).

3.8 Engineering and Architectural Accuracy

Ideogram showed a 47.1% superiority in this criterion, noting its accuracy in presenting the geometric and architectural dimensions of historical buildings. It is followed by Adobe Firefly with 41.2%, which indicates acceptable efficiency with some tolerances in dimensions or geometric accuracy. Midjourney, on the other hand, showed the weakest performance at only 5.8%, reflecting its inability to understand the exact architectural dimensions or present them correctly, as shown in (Fig. 9).

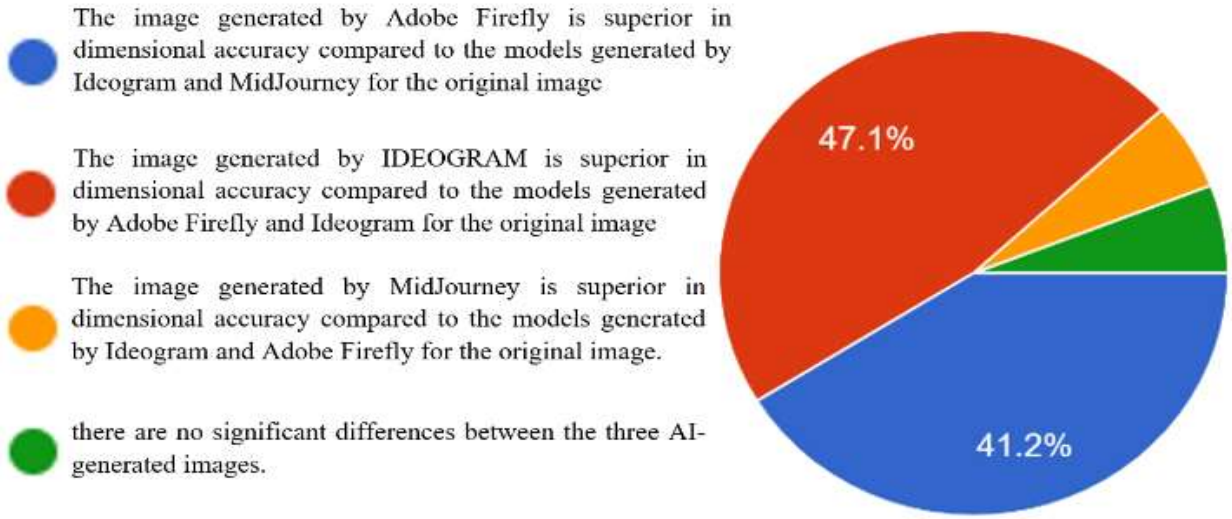

Figure 9. A form showing the questionnaire result for vocabulary (Engineering and architectural accuracy).

3.9 Preservation of Historical Character:

The Ideogram model received the highest score of 55.9% in preserving the historical character, reflecting its efficiency in simulating architectural features that preserve the historical identity. While Adobe Firefly scored a modest 23.5%, reflecting an average ability to maintain the general character, with a weakness in some details. As for Midjourney, it performed poorly, at 11.8%, which highlights its inability to take into account important historical characteristics, as shown in (Fig. 10).

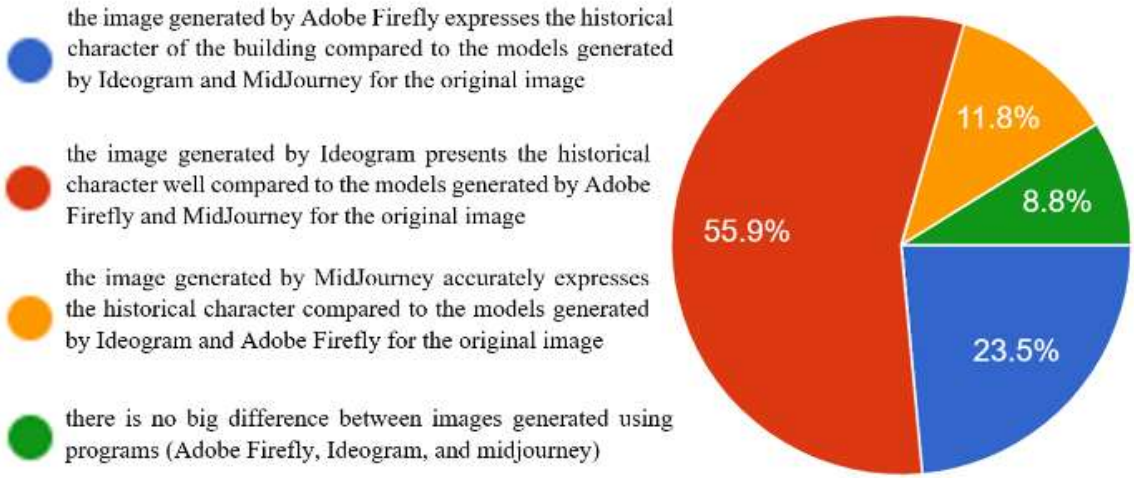

Figure 10. A form showing the questionnaire result for vocabulary (Preservation of historical character).

3.10 Lighting and Shadows

The results showed that Ideogram scored 50%, reflecting an average efficiency in processing lighting and shadows to deliver results close to reality. It was followed by Adobe Firefly with 35.3%, which indicates good performance, but less accuracy compared to Ideogram. Midjourney scored a very low percentage of 5.9%, which indicates its ineffectiveness in this crucial criterion, which greatly affects the quality of visual simulation, as shown in (Fig. 11).

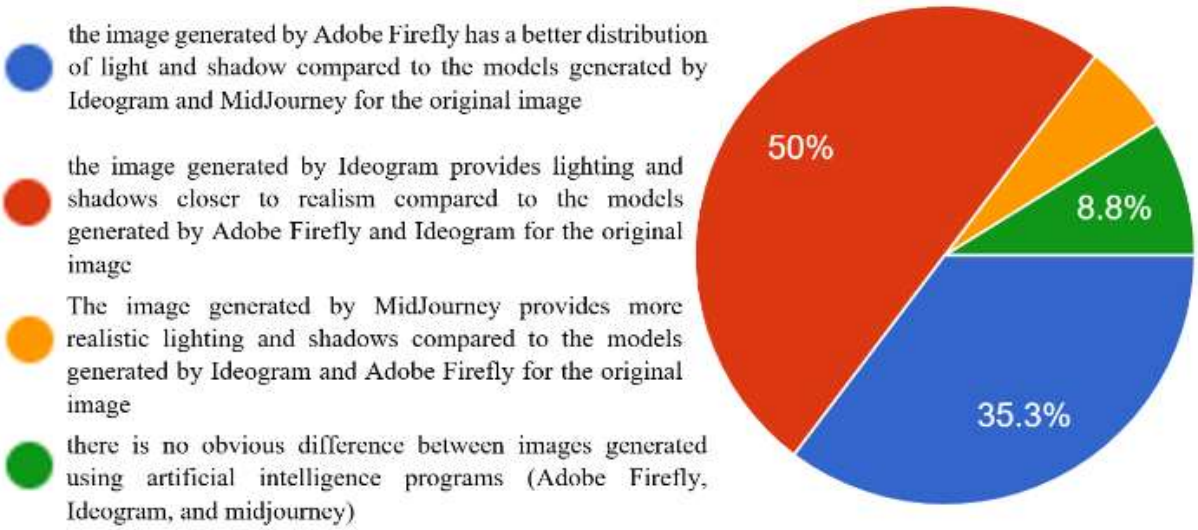

Figure 11. A form showing the questionnaire result for vocabulary (Lighting and shadows).

3.11 Preservation of Fine Details

The Ideogram model achieved the highest percentage of 47.1%, reflecting its superiority in preserving important details in historical photographs. Adobe Firefly came in second place with 44.1%, which indicates its good performance with some unevenness. As for Midjourney, it registered a meagre percentage of only 2.9%, which highlights its incompetence in this important aspect, as shown in (Fig. 12).

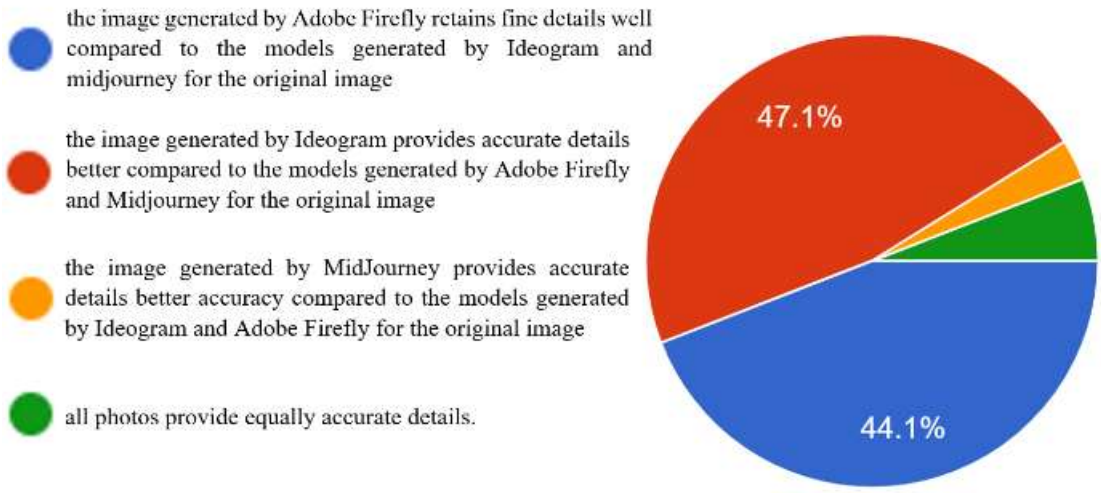

Figure 12. A form showing the questionnaire result for vocabulary (Preservation of fine details).

3.12 The Best Result for Digital Documentation

Ideogram again outperformed by 54.5%, which indicates its ability to choose the right photos that accurately reflect the historical character. It is followed by Adobe Firefly with 33.3%, reflecting an average performance in the selection of images. As for Midjourney, it showed the weakest performance by 6.1%, which indicates the weakness of its tools in this aspect, as shown in (Fig. 13).

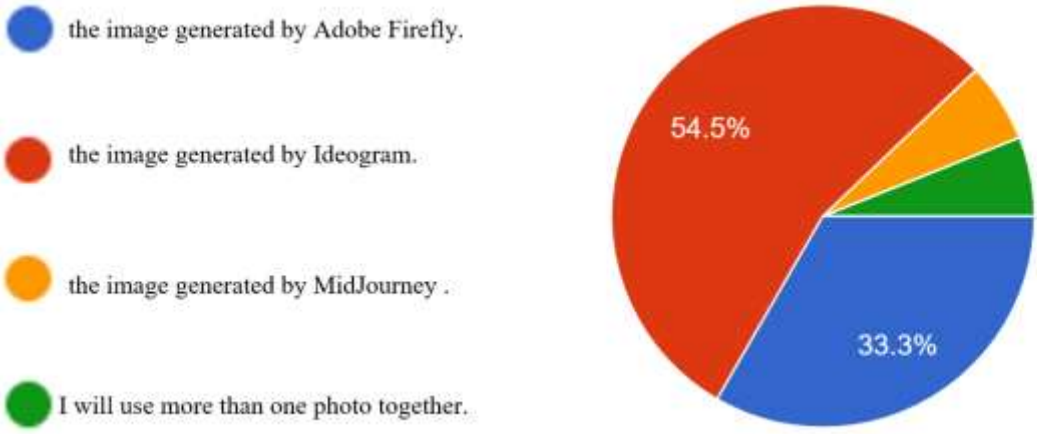

Figure 13. A form showing the questionnaire result for vocabulary (The best result for digital documentation).

3.13 The Level of Interference of Artificial Intelligence Tools on Model Characteristics

Ideogram scored a high percentage of 85.3%, which indicates its high ability to preserve the dimensions of the style and architectural proportions with minor changes. In contrast, Adobe Firefly achieved a modest percentage of 14.7%, reflecting its limited competence in this criterion. As for the Midjourney, it showed significant weakness with noticeable changes at the model level, which makes it less efficient compared to other models, as shown in (Fig. 14).

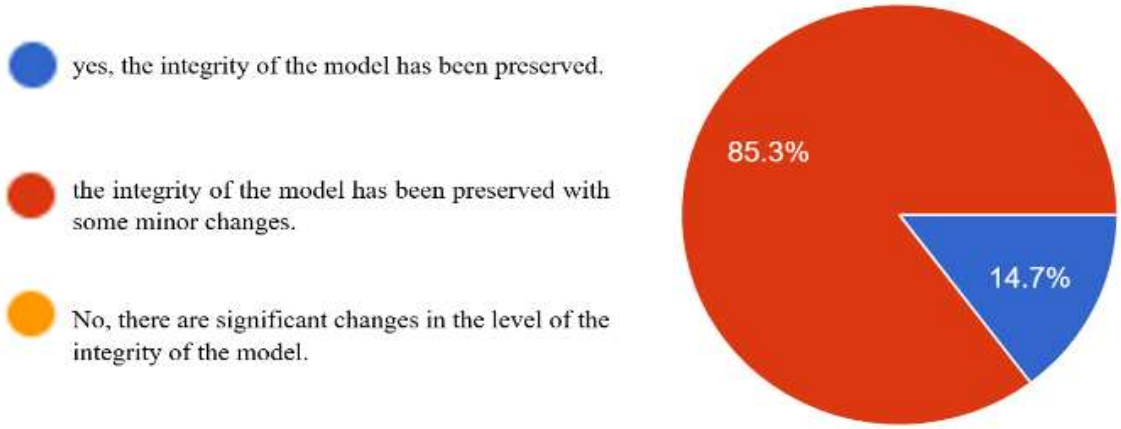

Figure 14. A form showing the questionnaire result for vocabulary (The level of interference of artificial intelligence tools on model characteristics).

4.0 DISCUSSION

Based on the practical application and the results of a survey of 34 experts in architecture, restoration and various specialties, the main results were as follows:

- The sequential process using ChatGPT for architectural analysis and various artificial intelligence tools for image optimization has established an effective framework for assessing the ability of artificial intelligence in the preservation of historical and heritage buildings.
- Among the AI models tested, Ideogram emerged as a superior AI tool in handling images, achieving the highest levels across critical criteria, especially the accuracy of decorative details (64.7%), the authenticity of materials (47.1%), and the preservation of historical character (55.9%).
- Adobe Firefly showed moderate and medium effectiveness, while Midjourney showed limited ability in the process of preserving architectural accuracy and historical integrity.

Therefore, these results highlight the importance of careful selection of AI tools in historical heritage preservation projects. While the performance of Avatars shows the potential of artificial intelligence in architecture simulation, the limitations of the study, including the size of research samples from 34 experts-indicate the need for further verification.

5.0 CONCLUSION

The research presented a framework for the potential of artificial intelligence tools for the Integrity of historic buildings at the formal, documentation, and development levels. It was found that the tools (Adobe Firefly program, ideogram, Midjourney, Dall-E, and stable diffusion) vary in their ability to achieve the Integrity of stylistic characteristics associated with the formal aspect. These include characteristics related to the monitoring phase/design principles that link formal elements (unity, dominance, diversity, rhythm, proportion, repetition) and characteristics related to the morphological aspect (color, texture, materials, light and shadow treatments). Achieving the Integrity of historic buildings using artificial intelligence tools is incomplete if it is limited to the formal aspect of facades, excluding the functional and aesthetic aspects, as these aspects are responsible for their stylistic characteristics. Most artificial intelligence tools, with the exception of a few, demonstrated shortcomings in dealing with complex architectural stylistic features. This suggests that these tools are essential for digital documentation and restoration, while further research is needed to determine their effectiveness. Programs that ensure the functional Integrity of historic buildings by preventing damage resulting from functional neglect and re-adapting their function.

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