Difficulty and complexity in dealing with visual pollution in historical cities: The historical city of Ibb, Yemen as a case study

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Abstract. The historical cities in the third world suffer from many environmental problems; one of them is the spread of visual pollution manifestations. These phenomena increase with low levels of public awareness and low per capita income. Despite the historical and cultural importance of the Old City of Ibb, the manifestations of visual pollution are increasing day after day. This study aimed at identifying the difficulty and complexity of dealing with visual pollutions manifestations in the historical city of Ibb and to provide appropriate solutions that are suitable for the complex and contradictory circumstances. The study relies on an inductive approach to achieve its aims through two methods; the first is a visual survey of the visual pollution phenomenon, based on images and observations. The second method is the analyses of the opinions and impressions of three parties related and interested in the phenomenon, namely residents and visitors of the city, competent authorities’ officials, and some specialists in the field of the urban environment. The study presents an analysis of the phenomenon of visual distortion of the historical city of Ibb in terms of its appearances and causes. Furthermore, this study provides appropriate solutions, which are suitable for complex and contradictory circumstances. These solutions focused on the methods to stop the spread of visual distortions, and the ways of addressing the current visual pollutions.

1. Introduction
Visual pollution is one of the hidden environmental pollutions that have spread in the urban environment and have negatively affected our daily lives [1]. It is an unorganized diversity of form, color, light, and materials [2]. Visual pollution refers to everything that negatively affects the visual image [3]; they are all human works and actions that harm the beholder’s eye [4]. The organizational errors and unresolved interventions of architectural and urbanism are one of the visual pollution manifestations that affect the urban environment [5], reduce the quality of the visual landscape [2], and create a distorted visual image of the place [6].

The studies [6] and [7] have classified the visual pollution malformations into (a) media surfaces and various ads (billboards, posters, commercial sculptures, signage, flags, etc.), (b) traffic vehicles (crowdedness, parking, and even bicycles in some built-up areas), (c) mass (business, education,
tourism), (d) transitory architecture (details, entertainment, and religious and political events), and (e) visual barriers (fences, temporary structure, etc.).

The most significant effects of visual pollution are lack of cohesion visual of environment, visual stress, the imbalance of the visual scene, and the loss of place identity that seem less harmful, but it offends our perception and psychological state, leading to the damage of many aspects of the human lifestyles of the communities [8-12].

The phenomenon of visual pollution is one of the most critical environmental problems affecting cities and destroying their visual image. The impact from the spread of visual pollution in historic towns is more critical since it leads to the loss of its cultural and civilization identity [3]. According to the United Nations Educational Scientific and Cultural Organization (UNESCO), local authorities and government must maintain the visual characteristics of World Heritage sites [13].

Visual image deterioration in most of the historical cities in the third world countries is increasing day by day. The problem has been exacerbated by the neglect of the competent authorities, the deterioration of the economic and cultural situation, and the lack of studies that address this phenomenon. The historical city of Ibb is suffering from a variety of examples of visual pollution of the urban environment, and it has been selected as a case study. The study aims to identify the difficulty and complexity in dealing with visual distortions in the historical city of Ibb and to provide appropriate solutions that are suitable for complex and contradictory circumstances.

The historical city of Ibb is characterized by unique architectural and urban elements, so before address the methods of study, we must take a quick look at the urban characteristics of the city.

![Figure 1. The historical city of Ibb](image)

2. Architecture and urban elements in the historical city of Ibb

The historical city of Ibb is located 193 km south of Yemen’s capital, Sana'a, situated on a high hill 2000 meters above sea level at the western edge of Riemann-Badan [14]. The history of the city of Ibb dates back to the tenth century, but some buildings date back to the Hamiari state in the first century, such as the White House, much of which has been destroyed [14].

The historical city of Ibb has a distinctive architectural and urban character. It contains many mosques, schools, palaces, markets, squares, walls, and other architectural and urban elements, which together form a cohesive urban fabric that expresses the identity of the city[15], as shown in Figure 1. The old city of Ibb has a harmonious architectural and urban character and the elements of visual architecture and urban of the city include:

- The historical city of Ibb is characterized by narrow and winding alleys, as shown in Figure 2. They are paved with stones, starting from the entrances of the city passing through the residential neighborhoods, markets, mosques, and schools until the Grand Mosque Square, and some of these alleys are covered with flat roofs or residential buildings[14].
The historical city of Ibb was surrounded by a stone wall from its four sides, which was 1450 meters, and its latest renovation was in the 18th century [16]. The wall includes four gates, which are: Al-Naser gate, Sounbel gate, The Big Gate, and Al-Rakiza gate, as shown in Figure 2. The city wall was not touched by any change until 1962, when the city began to expand to the outside areas. Openings were then made in the wall of the city, and parts of it were removed. Aside from this, some gates have been removed, and another one called the New Gates has been opened to allow cars to enter the historical city [14]. Changes in the wall have gradually increased, and many parts of it have been removed.

The historical city of Ibb consists of 33 residential neighborhoods separated by streets and narrow alleys that also lead to the squares, centers, and markets [17].

The historical city of Ibb is rich in historical and archaeological buildings that show the distinctive decorative style and the excellent use of traditional building materials [18]. The landmarks in the old city are varied and include mosques, schools, markets, and squares. The most distinctive landmark is the Great Mosque.

Ibb has many specialized covered markets and open markets (squares) selling various goods such as Al-A'ala square, Al-Asfal square, and Al-ga'a square [19]. The main market is located centrally, so that it is easily accessible from all parts of the city. Other markets are distributed according to their function, and some have been identified as the cause of environmental pollution and a disruption to the residents such as the blacksmith and butcher markets, and others located on the outskirts of the city [17].

People of the historical city of Ibb exploited the local materials in building and construction such as stones, natural wood, limestone, and Al-Qdad (a mixture of limestone and small stone balls). These materials were used as building, finishing and covering materials [20]. The clay was also used as a fill material inside the walls.

Figure 2. Map of the Historical City of Ibb.
• The façades of residential buildings are multistoried up to six floors, which are built of stone bearing walls [21]. The openings in the façades of residential buildings are varied and multi-sized and include: (1) Wooden windows: they are various and multi-sized, and tend to be more and larger on the upper floors rather than the lower floors and may not exist at the ground-floor level. (2) Al-Qamaria: it is a functional and aesthetic element that consists of circular or semi-circular openings made of alabaster or plaster with transparent or colored glass, (3) Al-Shakouss: it is traditionally used for ventilation and found above opening of Al-Qamarias level. The windows are sometimes covered with wood-paneled carpentry called Al-Mashrabia, which protrudes from the wall through wooden bridges as a kind of decoration for the façade of the residential building. They were also used to cool pottery vessels and prevent viewing from the outside [20], see Figure 3.

![Image of a building with labeled architectural elements]

Figure 3. The most important architectural elements in the façades of buildings

• The skyline in the historical city reflects the religious characteristic of the period in which the town was built [22]; as in all Islamic cities, it is characterized by the lighthouses and domes of the mosques. The topography of the region is also reflected in the skyline of the city, see Figure 1.

3. Materials and methods
The study employed the qualitative design to achieve its objectives through two research methods. (1) The study used a visual survey of the streets, squares, and the rest of urban built elements in the historical city of Ibb through authors’ observations and photographic documentation. Then, the visual distortions of the historical city have been analyzed and classified. (2) Interviews were carried out with a random sample of residents and visitors, as well as with officials in the competent authorities, and some specialists and those interested in the urban environment, to understand the perceptions of people who are related to this phenomenon or interested in it. The main aim of these interviews is to identify the respondents' perceptions of the causes of the spread of visual pollution in the historical city, and the suggested solutions to limit these causes. Based on the results of the field study, literature review and previous studies, the research presents a critical analysis of the difficulty and the complexity of dealing with the visual pollution of historical cities.
4. Results

4.1. Manifestations of visual pollution in the historical city

The study reports an analysis of the historical city image and the surrounding urban context through field observation and interviews with the local population. The following is a presentation of the most important manifestations of the visual pollutants of the historical city of Ibb and the surrounding urban context:

4.1.1. The new construction. Over the past two decades, the construction of new buildings in the city and the surrounding context has increased without consideration and respect for the traditional character of the old town in terms of building materials and architectural elements. Modern building materials such as cement and reinforced concrete have been used. Even where stones are used in the construction, builders did not use the traditional local stones. The builders used nonnative architectural elements in the façades of buildings that do not correspond to the traditional architectural elements in the historical city in terms of form and proportions. They further used inconsistent building materials and elements in the same building, according to the different periods of building construction, as shown in Figure 4.

![Figure 4. Visual pollution caused by new construction](image)

4.1.2. Ad hoc and unregulated construction to old buildings. Ad hoc and unregulated construction to the traditional buildings in the city are the most pervasive manifestations, distorting the visual image of the city, since most of the buildings have some form of addition, whether substantial or simple (see Figure 5).

![Figure 5. Visual pollution caused by ad hoc and unregulated constructions to old buildings](image)
4.1.3. The new city gates. In 2007, the Ministry of Public Works reconstructed the gates of the historical city, but in a characteristic that differs from the city’s characteristic style, as shown by comparing the photos in Figure 6 with the images in the rest of the figures, Figure 3, 5, and 8. The local authorities failed to preserve the historic fabric of the structures and did not take into consideration opposition from specialists in the field of architecture. The competent authorities re-built the gates using carved stones and the designs are separate from the urban context around them, which cause these gates to become an alien element on the urban fabric and one of the visual pollution manifestations of the city; despite that, the gates are considered one of the most critical features that characterized the city.

![Image of city gates]

**Figure 6.** City gates that appear separate from the general fabric of the city

4.1.4. Restoration of buildings’ façades. Much of the restoration works to the façades of buildings in the historical city are inconsistent with the original buildings. The lack of traditional building materials and the lack of skilled labor, which are knowledgeable in the restoration of historic buildings, are the two main causes for distorted restorations work. There is also lack of awareness for the preservation of historical buildings and no supervision by the competent authorities of the construction works (see Figure 7).

![Image of restoration work on building's façades]

**Figure 7.** Restoration work on the building's façades

The cement replaced the traditional, Al-Qdad, and oil-based and water-based paint replaced the limestone. There are also examples of machine-cut, non-local stones used in restoration and building works, instead of the traditional hand-cut native stones.
4.1.5. The Abandoned Buildings. Many of abandoned buildings in the city are derelict and structurally unsafe and will continue to deteriorate due to lack of financial resources to restore them and neglect from local authorities (see Figure 8).

![Abandoned and weak buildings in the historical city](image)

**Figure 8.** Abandoned and weak buildings in the historical city

4.1.6. Public Services and Infrastructure. The historical city of Ibb was electrified in 1962 with the introduction of the first services and infrastructure [23], which have since seen ad hoc additions of other services in the 1980s, such as telecommunication and later the internet, as shown in Figure 9. The indiscriminate use of these services has resulted in much visual distortion of the spaces, alleys, and façades of buildings in the Old City. Due to a lack of competent authorities' awareness in addressing this phenomenon, the impacts are becoming more widespread and complicated day after day.

![Visual pollution caused by electrical and telecommunication infrastructure](image)

**Figure 9.** Visual pollution caused by electrical and telecommunication infrastructure

4.1.7. Billboards and Signage. The indiscriminate use of billboards is one of the most important manifestations of visual pollution of historical cities centers in the Third World [24]. This phenomenon is widespread in the historical city of Ibb. It appears in the random variation of the sizes and shapes of billboards and banners, the drawing of advertisements on the walls, the writing of political slogans on the walls, and others, leading to distortion of the city's visual scene. (see Figure 10).

![Billboards and signage in the historical city](image)

**Figure 10.** Billboards and signage in the historical city
4.1.8. Garbage drums. Garbage drums have been distributed in the historical city of Ibb indiscriminately and are a source of visual distortion. The lack of community awareness about the importance of preserving the city's value is evident in the amount of rubbish found on the ground around the bins.

4.2. Residents and visitors' perceptions of visual pollution in the historical city
To investigate this phenomenon genuinely, it is necessary to measure the perceptions of the local population to the problems outlined, and to do this, interviews, rather than questionnaire were employed since illiteracy is a problem. The researchers conducted interviews with a random sample of residents and visitors of the historical city.

The interviews aimed to survey the opinions of residents and visitors about the causes and damages of visual distortion phenomenon in the city, to know how they perceive this phenomenon, and to seek their views on the proposed solutions to limit the spread of the phenomenon.

Analysis of the interviews shows that respondents are divided, not only over what represents visual pollution but how strongly they feel about it. Some residents simply do not see any problems and believe that ad-hoc construction and use of modern materials, as well as the appearance of electrical wiring and communication systems, do not represent visual pollution. On the contrary, they consider these factors to be a normal reflection of the requirements of modern lifestyles. Meanwhile, another segment of the respondents believes that the problem is significant, and they suggest that it could be considered as a crime against the historical identity of the city, which is continuously being destroyed.

Some respondents point to a lack of awareness of the importance of preserving the historical identity of the city, not only on the part of locals, but also of the competent authorities that neither help to maintain and repair buildings properly or issue and enforce laws to control construction works within the city. These respondents also suggest that the demand for the modern and trendy, including the latest building materials and techniques that were used in construction and restoration works of the old city, have contributed to the creation of visual pollution. By contrast, respondents who are not interested in heritage believe that the old buildings have become damaged and that the cost of restoring them by traditional methods is too high, and therefore that it is best to renovate using contemporary construction materials and modern techniques.

Most of the interviewees agree that the competent authorities are responsible for the visual and environmental pollution caused by garbage and garbage drums. It is suggested that the relevant authorities did not provide adequate garbage bins or distribute them efficiently in all the lanes, and that there is a lack of awareness among residents and visitors about the importance of maintaining city cleanliness.

Regarding the damage caused by visual pollution, some respondents believe that the significant damage manifests in the behavioral and cultural aspects, including the decline in the level of peoples'
aesthetics. Respondents also believe that the prevalence of visual distortions in the old city prevented it from being classified as a World Heritage Site. On the other hand, those respondents who are not interested in the heritage and identity of the city see only the environmental pollution caused by garbage, and that the damage as the visual distortion manifestations are not important. Regarding the suggested solutions, most of the interviewees believe that the competent authorities should renovate the buildings and public facilities continuously and correctly, and issue strict laws to reduce the visual distortion in all its manifestations and types.

4.3. Competent authorities’ perceptions of the visual pollution in the historical city
As part of the study, interviews were conducted with city officials in the competent authorities to understand their perceptions of the manifestations of visual distortion in the historical city of Ibb, including those caused by new construction or additions, restoration works, and advertising and billboards. As a justification for why they do not fulfill their role in preventing the distortions in the city, the officials of the competent authorities referred to some obstacles. These obstacles include the lack of awareness about the importance of preserving the identity of the historical city and the current building codes which do not act as a deterrent to unpermitted works and therefore, do not encourage the preservation of historical cities, as well as the restoration of buildings without official permission, lack of specialists in the restoration of archaeological buildings, and lack of interest of the research bodies on the subject of maintenance and repair of archaeological buildings. The authorities all suggested some solutions as follows: raising public awareness of the importance of preserving the city and its characteristics, increasing the interest of research bodies in conservation and restoration of archaeological buildings, and developing the building codes and laws.

4.4. Perceptions of academics and professionals in built environment on visual pollution in the historical city
Most of the academics and specialists in the field of architecture and urban environment also highlighted the main points from the results of the field study regarding the manifestations of visual pollution in the historical city of Ibb. Their responses about the adverse effects of the visual distortion in the city can be summed up as follows: progressive disappearance of the architectural character of the city, sense of a loss of place and belonging, the complexity of any future treatment, and the adverse effects on people's behavior. The respondents pointed out some obstacles, which stand as an attempt to address the visual pollution phenomenon in the historical city. They are low awareness about the importance of preserving the historical city identity, low economic level of the city's population, and lack of knowledge of the competent authorities about their role in the preservation of historic towns. Most respondents referred to some issues that could represent solutions to reduce the spread of visual pollution, raising awareness of the importance of preserving the identity of the city, issuing appropriate legislation, activating the role of the competent authorities, and providing job opportunities for the residents of the city.

5. Discussion
Sivaramaran has referred to a range of visual pollution aspects that affect the built environment in his book, Visual Pollution: An Aesthetic Pollution Causes Eyesore. These include sightings of garbage dumps, exposed waste, construction waste, writing on the walls, billboards, telephone poles, vehicles, abandoned buildings, unregulated grasses and shrubs, beggars, vehicle lamps, and others [25]. He has pointed to manifestations of visual pollution for cities generally while Portella and Reeve [24, 26, 27] have referred to visual pollution in historical cities as that resulting from advertising boards. Destroyed buildings were referred to as one of the manifestations of visual distortion in Cercleux [28]. Thus, we can summarize the manifestations of visual pollution in the historical city of Ibb as:

- The new construction within the urban fabric of the historical city and the surrounding urban
context, which uses modern building systems and materials, and the architectural formation of the façades that are entirely incompatible with used in the old urban fabric.

- Structural additions to the existing buildings (new rooms, floors, walls on roofs, walls in front of the buildings), which use modern building materials and techniques.

- Thoughtless use of modern building materials regarding shape, color and method of implementation in the renovation and restoration works of residential buildings, some mosques, and other buildings.

- The inconsistency of new gates implemented by the Ministry of Public Works in 2007 with the local context of the historical city.

- The abandoned buildings.

- Advertising boards, signs, and writing on the walls of buildings.

- Street furniture, stools, stalls, lighting poles, and others.

- Requirements for public services and infrastructure such as electricity, telephone, and satellite channels.

- Garbage dumps on streets, squares, and urban spaces.

As one of the historical cities in the third world, the visual pollution of the historical city of Ibb is increasing day after day, which makes the process of reversal more complex. The difficulties and challenges of trying to address visual pollution in the historical city of Ibb can be discussed at two levels; firstly, the economic, social, cultural, and political conditions and challenges, and secondly, the technical and administrative issues. The first level relates to the general difficulties of economic conditions and the cultural and social aspects. That is, the economic conditions of the city's residents are difficult, and the per capita gross domestic product (GDP) in Yemen is low at less than $1350 per year[29]. Also, there is low public awareness of the importance of preserving the identity of historic cities. In addition to the weakness of the state, there is lack of institutional procedures, as in most countries of the third world, and corruption in government institutions is high. The second level of difficulties and challenges is related to technical and administrative issues, as the scarcity of skilled workers in the use of traditional building techniques and the lack of traditional building materials with the availability and flexibility of modern building materials. Besides, negligence and ignorance among the competent authorities, the current laws and legislation are not sufficient to reduce the deterioration of the visual image in historic cities.

Through interviews with city residents and visitors, the officials of the competent authorities, and academicians and specialists in the field of architecture and urbanization, the researchers noticed an exchange of accusations between the relevant parties. The competent authorities indicated the behavior of residents and lack of research support from research institutions as the causes for the prevalence of visual distortions in the city. Besides, there is lack of awareness among residents, and lack of commitment to the urban character of the city when they carry out the restoration works or additions to buildings. In terms of research institutions, they neglect supporting the studies that assist the competent authorities in the development and preservation of historic areas. Moreover, the city residents blame the competent authorities for not providing financial support to people to help them in the implementation of the restoration works correctly. The specialists and academics cast blame on the weakness of laws and the absence of control in addition to the lack of awareness of the residents. Therefore, it is through the above-mentioned exchange of accusations that one can infer the weak communication between the three relevant authorities. This is also one aspect of the difficulty and complexity of dealing with visual distortions in historical cities.
A large segment of the city’s residents believes that the visual distortions are not considered a problem, indicating a lack of awareness of the value of the historic city. On the contrary, as an example, the residents of Kamakura city in Japan protested against the destruction of the natural and historical environment. As a result, the government pushed a new law to preserve the historical features of ancient capitals. This highlights the awareness of the residents of the importance of maintaining the historical value of old cities [30].

The discussion of the treatment of visual pollution in historical cities should be based on coordination and integration between relevant parties (residents, competent authorities, and research institutions) related to the phenomenon of deterioration of the visual image of the historical city. The solutions can be addressed in two ways; the first aspect concerns proposals to stop the continued spread of visual distortions in historic cities as follows:

- Organizing awareness sessions and seminars for the residents of the city regarding the importance of preserving the city's identity and character.
- Encouraging, reviving and rehabilitating handicrafts projects which represent the recovery of city life and source of income for the residents.
- Providing an architectural and construction guide, which can be used during construction, restoration and maintenance work in historical cities.
- Conducting research studies for the development of modern building materials to achieve the traditional visual characteristics and modern economic advantages.
- Developing the current building codes and the law of preservation of historical cities, which must include the conservation of the visual image in a more detailed and rigorous manner.
- Activating the supervisory role of the competent authorities.
- Coordinating and integrating between the parties (residents, competent authorities, and research institutions) related to the issue of deterioration of the visual image of the historic city.
- Including courses to develop taste and a sense of beauty at all study stages.
- Increasing the attention to the issues of urban design and regeneration in research institutions. There are no specific departments of urban planning and design in Yemeni universities, which are still dealing with urban issues as a few courses in the departments of Architecture[31].

The second aspect is related to the treatment of the current visual pollution in the historical city of Ibb. The most complex matter of the current situation is the new buildings and additions that do not correspond to the fabric, and the architectural and urban character of the city. It is impossible to make any major modifications because of the financial conditions of the state and citizens, which do not allow for the removal and rebuilding. The solution of this situation is through providing a universal architectural and urban study. The following are some suggestions which can be taken into account:

- Carrying out detailed monitoring of all aspects of visual pollution in the city in terms of the type of visual pollution, determining it by number or area m², its location, the ownership of the building in which the visual pollution, the proposed treatment, the cost of treatment, etc.
- Since it is not practical or feasible to remove structures that were built using modern building materials, improvements can be made to their façades to augment their appearance. Interventions can include painting the façades and covering them with stones, woods, and local finishing materials to may make them look more in keeping with the surrounding environment and the city's traditional architectural style.
- The city gates that were reconstructed by the Ministry of Public Works in 2007 in a manner
that differs from the city’s architectural style must be redesigned; the new design should be harmonious with the surrounding built environment.

- Restoring abandoned buildings in the Old City using traditional building materials and techniques to suit the local context.
- Using traditional building materials and techniques when carrying out any repair, addition, or maintenance.
- Removing all electricity and telephone wires, and sewage extensions, then implementing them through tunnels underground, or exploiting the tunnel located in the city for this purpose.
- Removing all billboards and advertisements, and then issuing new models which should be homogeneous and consistent and consider the psychological need for uniqueness and distinction among store owners.
- Re-employing unused buildings and reviving popular markets.

6. Conclusion
The visual pollution phenomenon in historical cities is one of the most complex environmental issues, especially in third world countries. The historical city of Ibb is suffering from the spread of visual pollution and the deterioration of the urban environment, leading to the loss of the city’s historical identity and distinctive architectural character. Therefore, to address the deterioration of the visual image of the historical city of Ibb, all concerned parties (residents, competent authorities, and research institutions) must make significant efforts in joint coordination.

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