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The Future of an Intelligent and Responsive Architecture Design After The COVID 19 Epidemic

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Abstract. An intelligent building is much more than a set of walls; it's a dynamic organism that employs integrated technologies to share data about the building among various systems to enhance efficiency and provide a better experience for its users. There are a number of challenges with intelligent buildings. They must respond to people's requirements and needs, including their health and well-being; they must be resource-efficient, and they must include the most useful aspects of new technologies. The current COVID-19 outbreak has pushed architects to consider the future of architectural design technologies. Is it possible that the epidemic may influence the design of our buildings, causing them to become smarter or more intelligent? What role did architecture play throughout the epidemic and in the post-pandemic stage, as well? This paper aims to discuss the future of intelligent design technologies in light of the current Coronavirus epidemic and how it might reshape our architecture design. Finally, the impact of COVID-19 on people's daily routines in the building design will be discussed.
***Keywords*:** Coronavirus, COVID-19, Intelligent Architecture, Post pandemic architecture, Architecture design.

INTRODUCTION

Throughout history, diseases have shaped our buildings and cities. Cholera inspired modern street grids in the same way as malaria and plague influenced and left their fingerprints on architecture designs and urban design. In the nineteenth century, pandemics caused dramatic changes in city layout to reduce overcrowding and enhance insufficient sanitation, which helped in the speedy spread of the virus. If Covid-19 could be extinguished rapidly, it is unlikely that the urban fabric will be greatly altered. Malaria, cholera, and plague steadily damaged cities. Individuals thought they would either stay or never go, so they pushed for reform [70]. On the other hand, Covid-19 is unique in that it has hit both isolated ski resorts and suburban areas. It has nothing to do with the density. The current outbreak is not confined to a city-only, as the previous outbreaks have been[62,14,60,21]. It is dependent on spread speed, and our ability to constantly move nowadays has provided it with a platform. What is clear is that the global will become a different place for many coming years; nevertheless, all types of crises, whether socio-cultural, environmental, or economic levels, provide positive opportunities for progress.

Intelligent buildings in the light of the COVID-19 outbreak

Architects, urban designers, engineers, and public health specialists have all played a role in past efforts to stop pandemics [37]. Architects, engineers, and urban planners will emerge as the new "treaters" trying to stop future epidemics[37], just as they did in the 1800s with the redesign of Paris or the 19th-century cholera episode in London [36]. As a result, architecture design is thought to have been an essential tool for responding to and even preventing formidable viruses. We are currently dealing with COVID-19, which is no exception. In the short term, the changes to the way our buildings and construction work have been significant, and they are predicted to happen sooner or later. Our buildings will one day change and adapt dynamically to complexities through intelligent and smart design technology, allowing us to better prepare for change.

To flatten the COVID-19 curve, the best options for the global to cope with the virus right now are social isolations, hand-washing, and wearing a protective mask. However, technology may slow the virus's spread by detecting and monitoring new cases early on [36, 10, 32].

Even though emerging technology will exacerbate problems, opportunities have arisen to implement innovative solutions in the direction of more intelligent and virtual reality applications of building design. We are replacing conventional physical places with digital ones that could be accessed through smart devices as we gradually operate from a remote space, upgrading as well as learning skills online, and purchasing what we need from websites[22,23,18,19,20, 31,41,54]. Increasing reliance on the internet media in building design, taking account of its effect on lifestyle, could continue after the COVID-19 outbreak, affecting all aspects of design and urban planning. Society seems to be facing a global crisis, perhaps the most severe in our generation. Various emergency measures may become routine, modifying attitudes and perceptions; they could balance opposite positive or negative interventions in cities and approaches to building design.

Before the current outbreak, the business sector focused on occupant comfort with well-being in recent years. Businesses and building owners looked to intelligent building design technology to help sustain a comfortable, sustainable, affordable, and engaging environment, acknowledging that occupants are the most precious asset in the design. Unfortunately, on a global scale, the pandemic is interfering with this development. The current outbreak has put the world's system into pandemonium. As a result, many people choose to work from home to help limit virus spread.

As employees return to office buildings and shops, businesses and building owners must schedule, plan, and prepare to that return [41, 42-61]. Technology, particularly intelligent design technology, can help in this situation. As a result, intelligent design technologies may play a vital role in private and public sectors, allowing employees to return to work and public areas and stores to reopen. In addition, the current pandemic has necessitated the extension and convergence of intelligent and smart design technologies [27,57,58]. Previously, intelligent design technologies were predominantly utilized for security, remote monitoring, and environmental monitoring during lockdown times. Now, we'll need them to help manage building occupancy levels and monitor social isolation [56,57,50,60, 62.]

According to Atkin (1988), intelligent buildings are that buildings "know" what is gone on inside them as well as outside, as well "decide" the effective ways to deliver a better environment for their occupants and their needs (Atkin, 1988).

Voice-activated elevators, automatic control devices, and buildings monitored by mobile phones might all be utilized to decrease physical contact and virus transmission[56, 47, 59, 44]. Some designs for social distancing solutions have already been established, like the hyperlocal micro-market[41]. Many works have been done to recirculate polyemers and use them for such cases [55,56, 12,13,79]. Others trying to use different types of composite materials in buildings although the researchers previously used them for different purposes the importance increased recently [60,61, 1-8, 54, 37,39,48,38, 36, 45, 42,43, 46, 28,29, 11,12].

The Manser practice studio in the UK has proposed how post-epidemic techniques in hotels might work to maintain social distancing and decrease contacts through surfaces. (Figure 1), (https://www.dezeen.com/2020/05/21/post-pandemic-hotel-manser-practice/).

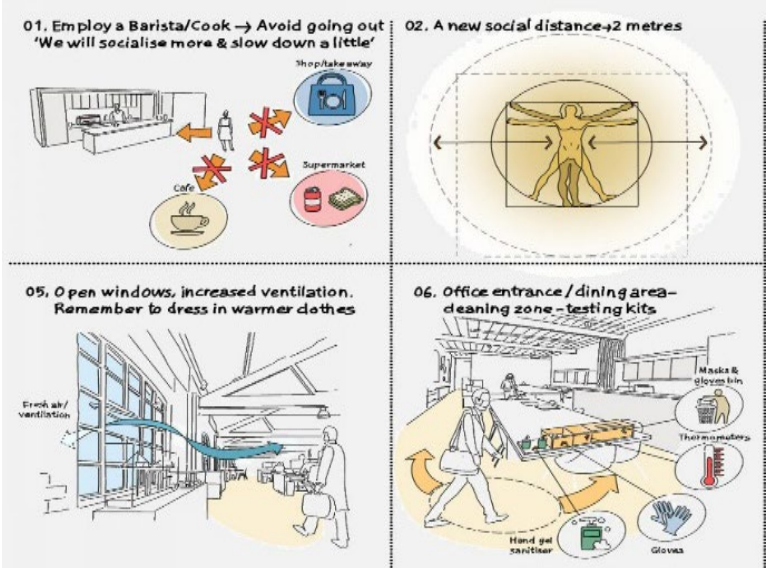

Figure 1: Predicted ways for preserving social distance in hotels and the workplace. https://www.dezeen.com/2020/05/14/weston-williamson-social-distancing-office/

Some healthcare, retail, leisure, and aviation companies are already using intelligent building technologies to diagnose virus infections and limit their spread [59]. Infrared cameras, for instance, have been set in various airports, malls, and hospitals thru out the world to check body temperature. In addition, water sensors are also being used in several hospitals and clinics to verify if staff and patients are washing their hands effectively [23-25,55]. Many authors investigated different methods to purified polluted water using low cost sustainable methods [14-16, 23, 51,52, 57, 60-62, 62, 54,55, 10, 34, 48-50, 34.]
There is a greater need for improved air quality and much more efficient design ventilation to reduce virus survivability with the present epidemic. In addition, people will be less likely to touch light switches, electronic items, or elevators after the epidemic, resulting in an increasing number of touchless devices in a building, such as hand-free doors, sound-activated lifts, and mobile-controlled central door locks [9,32, 33, 40, 27, 50].
In terms of architectural design solutions, post-epidemic buildings may have more partitions across areas, and the open spaces end. A wide corridor and entrance, and several additional stairwells, may demand architectural alterations and new design strategies. The building's sustainability can be improved by providing flexible and adaptable spaces for all inhabitants, enabling it to adapt to different needs and lifestyles. (Figure 2), [33, 60, 48].

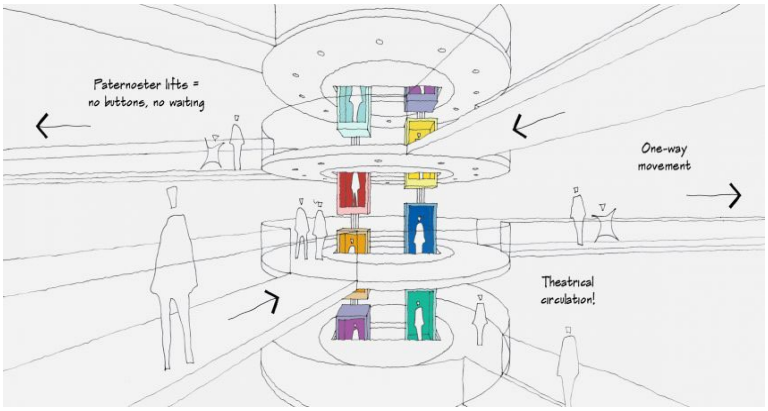

Figure 2: One-way systems may be implemented in buildings, and the paternoster lift could be rediscovered. (https://www.dezeen.com/2020/05/21/post-pandemic-hotel-manser-practice/)

Intelligent building design will assist individuals in making the best future choices [56,61]. By addressing many issues raised through the current outbreak and initiatives in intelligent design techniques are expected to increase in the future to help people better prepare for future crises. For the first time, this research aims at collecting the opinions of relevant peoples on the possibility of implementing intelligent design techniques into a Baghdadi building design concept. This study is being conducted to examine technological feasibility and any social and cultural issues that would provide a barrier to implementation.

METHODOLOGY

This paper presents a synthesis of the public opinions on the possibility of implementing intelligent design techniques into a Baghdadi building regarding environmental and cultural performance, as gathered through an online survey. The data collected were analysed using Microsoft Excel software. Tables and figures were used for illustration and analytic purposes.

The purpose of the questionnaire was to evaluate the public awareness of COVID-19. The participants were asked to develop a viable solution for restricting the spread of the virus in a building. Respondents were also asked about any issues or challenges they or their families would have due to the coronavirus's spread.

A survey of 48 professionals was conducted using online resources to assess their views on COVID-19 and their understanding of COVID-19 in the building industry.

The study offered the investigative survey results to better understand the public's perspectives on combating the spread of the virus in a given building. It is essential to consider the publics' opinions about a building's past and present. This is not only because they appreciate the difficulties the country faces in constructing a modern Baghdad, but also provide an opportunity to explore how intelligent buildings can be designed which take into account Baghdad's climatic and cultural conditions.

RESULTS AND DISCUSSION

The questionnaire reached 140 participants, 110 of whom (78.6%) were responded and completed it successfully. The respondents were very helpful in answering the questions, although the researcher had difficulties explaining each question to every respondent.

The survey was designed to consider the respondent's opinions and build upon the literature findings informing a more up-to-date understanding of the occupation experience and the possibility of implementing intelligent design techniques into a building in the current climate and socio-cultural context that remains unreported in the existing literature.

Table 1 shows the participants were divided into five age categories and four main groups of education levels. The respondents' ages and educational levels were varied so order to elicit a range of viewpoints on how to control the spread of the virus in a building.

Table 1: Respective gender and age ranges

Gender and age of the respondents	**Gender?**	Male
		Female
	Age?	From 18-24
		From 25-34
		From 35-49
		From 50-60
		More than 60
Academic education level	**What is your highest qualification?**	Diploma
		Bachelor's Degree
		Master Degree
		Ph.D. Degree

Table 2 and Figure 3 show the gender and age ranges. As shown in Table 2 and Figure 3, the distribution of gender in this survey was 48% (53/110) males and 52% females (57/110).
Most of those questioned (79%) were between the ages of 35 and 60, and were of both genders. However, 84% were under 60 years old, while the smallest group (16%) was under 60 years old. This is a positive sign that the respondents had enough judgment and experience to participate in this research.

Table 2: Respective gender and age ranges

Age	18-24	25-34	35-49	50-60	More than 60	Total	%
M	0	3	17	23	10	53	48%
%	0%	6%	32%	43%	19%		
F	2	18	13	16	8	57	52%
%	4%	31%	23%	28%	14%		
Total	2	21	30	39	18	110	
%	2%	19%	27%	36%	16%	100%	

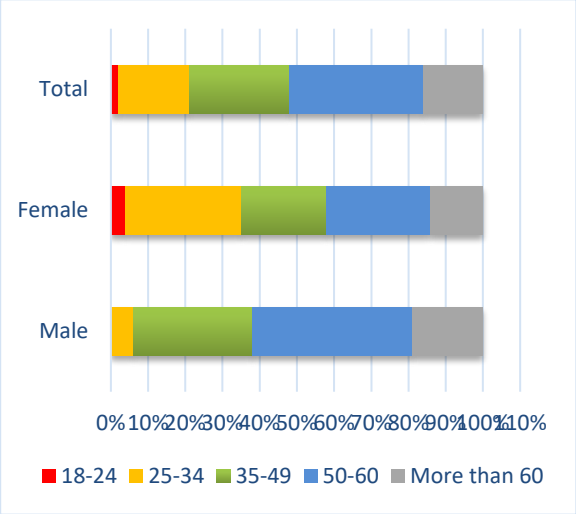

Figure 3: Respondent's gender

Table 3 and Figure 4 show the respondents' different education levels, divided into four main groups. As shown in table (3), majority (41%,45\110) hold a university certificate (bachelor's degree) followed by the number of those who hold master's degrees 35% (39/110), while 16% (15\110) have a Ph.D. degree. The level of education is considered an important aspect that may influence respondents' opinions towards and understanding of the content of this questionnaire, particularly relating to architecture and intelligent techniques.

Table 3: *Academic educational levels*

Age	Diploma	Bachelor's Degree	Master Degree	Ph.D. Degree	Total	%
M	3	17	23	10	53	48%
%	6%	32%	43%	19%		
F	7	28	16	6	57	52%
%	12%	49%	28%	11%		
Total	10	45	39	16	110	
%	9%	41%	35%	15%	100%	

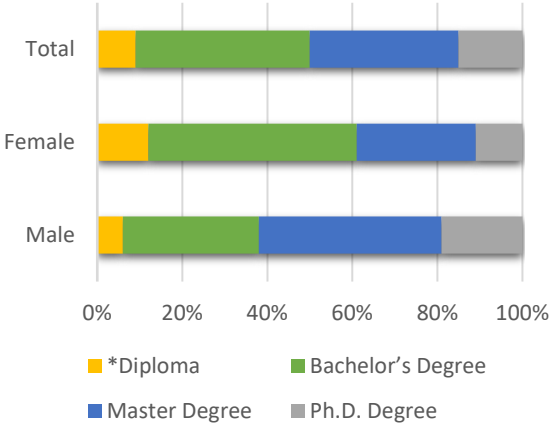

Figure 4: *Academic educational levels*

Our motivations for going to work have crystallized due to the significant shift toward working remotely from home. When asked about the most motivating reason employees came to work, respondents favored things focused on people and culture, such as scheduled meetings, social activities, and face-to-face communications.

Figure 5 shows the ranking results. Again, all proposed items had strong support (60-89% of responses ranked as essential.

As shown (in Figure 6), the public agreed that meetings with a colleague to discuss the schedule is an important aspect to consider. The drastic change to working remotely at home has crystallized our motives for going to work. Respondents primarily preferred familiar social and cultural events, such as scheduled meetings, social activities, and face-to-face communication, when asked about the most convincing reason for employees to come to work. Access to technology and the opportunity to concentrate on their jobs were also important factors for over 89% of staff.

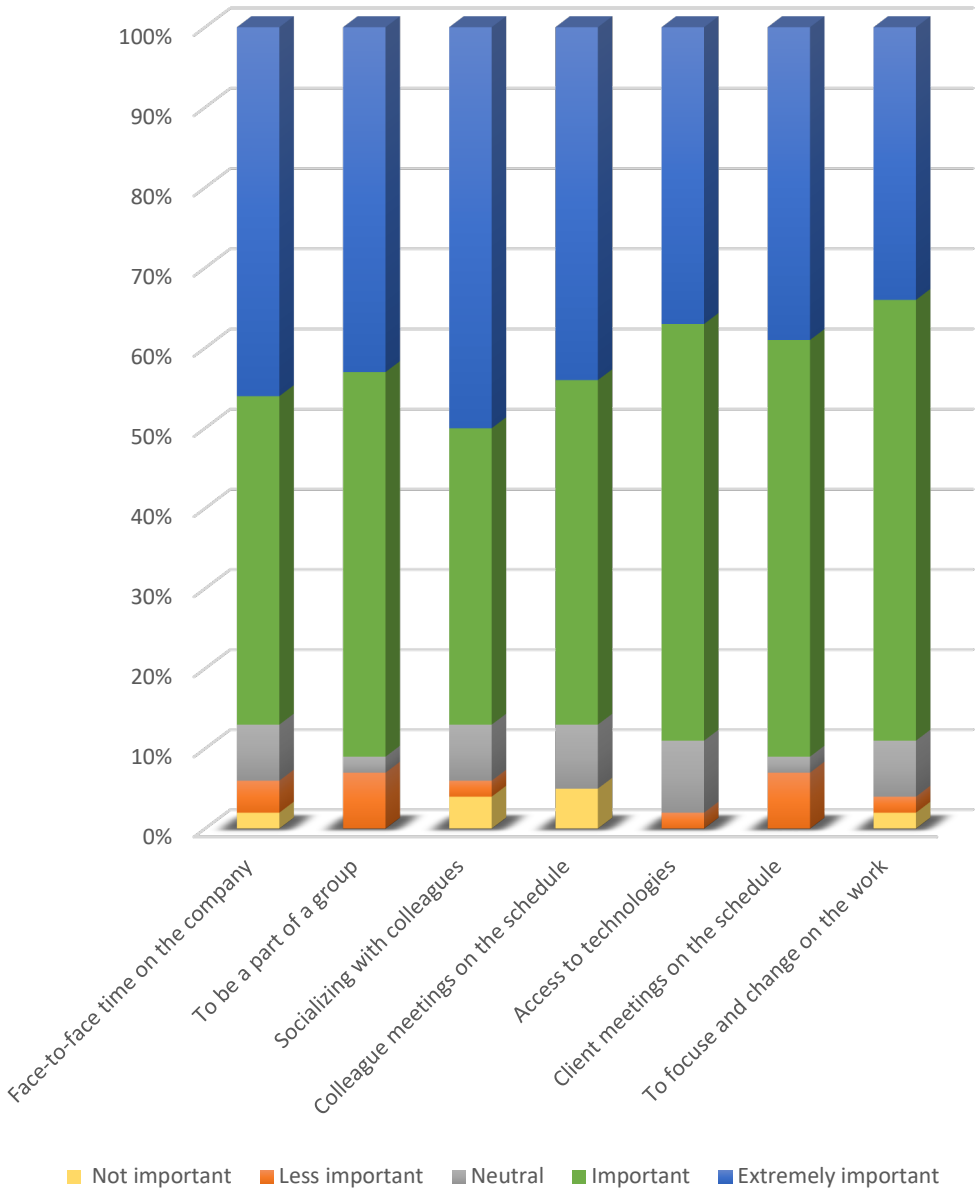

Figure 5: *The most convincing reason for employees to come to work*

As a result, most people choose socializing with colleagues and being a part of a group as the most important reasons for employees to come to work. When asked what they miss most about working from home, participants' responses reaffirmed the importance of individuals: four out of five survey respondents listed ‘the people' as their top priority. Collaboration and staying informed about others' activities and projects are sometimes more challenging’s at home than at work, emphasizing the significance of physical presence and interactions (Figure 6).

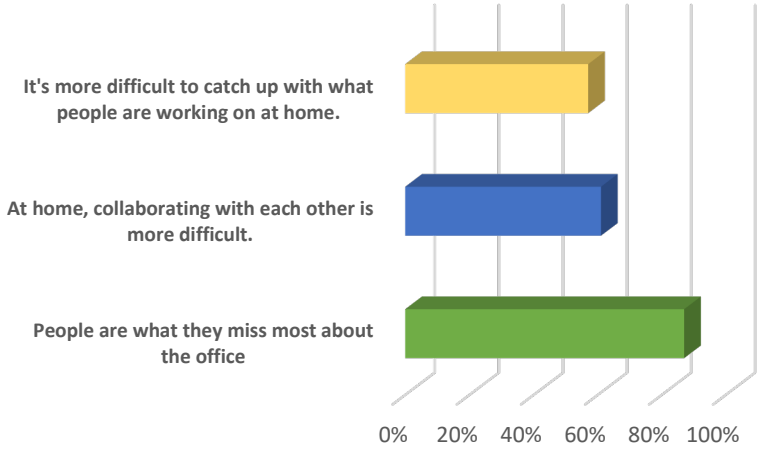

Figure 6: *It's challenging to collaborate and connect with colleagues when you work from home.*

When asked whether they thought intelligent design techniques should be used in Iraqi buildings currently or in the future (and why), 88% of participants answered yes, while 12 % answered no (Figure 7). The reasons behind these ratings given by the experts may be are summarized as follows:

- Socio-cultural;
- Technological;
- Governmental.

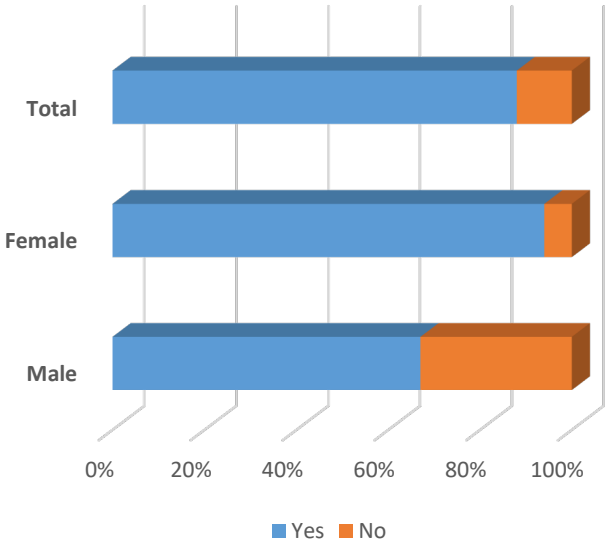

Figure 7: *Application of intelligent design techniques*

Figure (7) illustrates that the vast majority of the public agreed that intelligent design technologies had offered the best solution in the COVID-19 outbreak and had proven suitable to the climate. By addressing many of the problems

posed through the epidemic, intelligent buildings will assist society to plan better for the future, and advances in intelligent design technology are projected to increase over time to assist individuals to deal better with future outbreaks.

Public agreed that if intelligent design approaches were effectively appropriately implemented, they may greatly improve future buildings and develop a distinct local identity. However, they also emphasized the importance of persuading individuals to accept these ideas.

This section examines the public's opinions and viewpoints on the design of intelligent buildings in light of Iraq's climatic and sociocultural factors. The goal is to understand better the issues that the country faces in developing a modern Iraq and consider future techniques of building intelligent designs.

According to the survey, intelligent buildings will help people deal better with the future by solving many of the issues raised by the COVID-19 outbreak. This will drive more investment in smart design technology, which is intended to assist people to deal with new epidemics in the future.

Despite efforts to improve intelligent building technologies, according to the survey, the government does not provide adequate support. As a result, the government is required to take the lead in enacting more detailed legislation. For example, building guidelines and standards should be improved and enhanced to provide specific guidelines to architects, designers, and users, minimizing the number of inefficient procedures. Architects and designers could also be included in the design stages to inform their professional practice. In addition, the government must attempt to manage marketplaces and encourage the use of specified design strategies for future design.

CONCLUSIONS

COVID-19 is thought to spread quickly from person to person or through contact with virus-infected surfaces. However, the current outbreak gives us essential lessons about modifying contemporary architectural design and dealing with a new design. One thing is certain: investing in intelligent architectural design technology will benefit everyone. These technologies provide an added level of insight and control that is not only environmentally benign and resource/energy efficient but can also contribute to more efficient and sustainable real estate that is ready for tomorrow's challenges.

Following our discussion of how COVID-19 is influencing and changing our everyday life, economy, and community, as well as the role of technological innovations and increased public awareness of intelligent design technology solutions, we can conclude that intelligent architecture has a bright future, despite the coronavirus epidemic. According to the survey, intelligent buildings will help people effectively prepare for future outbreaks by addressing many of the issues that arose during the COVID-19 epidemic, and investments in smart technologies are expected to rise over time to help populations prepare for future epidemics. The cultural barriers that have prevented the development of intelligent buildings were also underlined in this study. These led to suggestions for removing these barriers and the social, economic, and environmental benefits of doing so; the study also examines how intelligent building benefits may be included in new design.

It is important to include public opinion since it not only raises awareness of the challenges the country confronts in creating a contemporary Iraq, but it also allows for future design strategies to be considered.

The lack of government support, despite efforts to develop intelligent building techniques. Therefore, it is critical to press the government to take the lead in implementing more explicit rules.

Designers and architects should be active in the design phase to inform their professional actions. Additionally, the government must work to maintain market control and encourage the usage of intelligent design techniques in the future.

While social distance seems to be an essential (though probably temporary) step, it's reasonable to assume that fear of future viruses will motivate architects to design with large open spaces in consideration, permitting and encouraging users to spread out. In addition, we expect that the vision of future intelligent technologies will encourage interdisciplinary research and the establishment of linked environments, allowing the world to be better prepared for future outbreaks of infectious viruses.

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