Understanding the Role of Architect in the Artificial Intelligence Era - "An Approach to AIA in Egypt"

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Abstract

AI is a fast-emerging field and is becoming an essential part of our future. Recently, most of used technologies are somewhat artificially intelligent, where it still needs human involvement to carry out the main part of the task. AI has a significant impact on multiple fields and industries, like IT, cybersecurity, medicine, and manufacturing since it provides them with countless creative opportunities. Compared to the mentioned fields, the development of AI in Architecture is still not commonly used. The dominant idea related to Architecture is that designers will be replaced by smart robots to create art and design buildings. But on the contrary, the open-ended creative results are still preserved for humans only. AI can do endless tasks during Architecture design process requiring human intelligence such as decision-making. Therefore, it is crucial to understand the role, advantages, and disadvantages of this technology within the design process from the viewpoint of professionals. Consequently, a Questionnaire will be held to several Professional Designers, Architects, and Researchers, then a summary of their responses will be reported in this article. The aim is to recognize how AI techniques can affect the Architect`s attitude to the design project.

1. Introduction

Nomenclature	
AI	Artificial Intelligence
AEC	Architecture, Engineering, and Construction
AIA	Artificial Intelligence Architecture
BIM	Building Information Modelling
DL	Deep Learning
EPA	Environmental Protection Agency
EV	Electric Vehicles
GHG	Greenhouse Gas
IoT	Internet of Things
ML	Machine Learning

Recently, the enormous progress of digital tools and the appearance of vastly technological advancements for example Artificial Intelligence (AI), Machine Learning (ML), and Deep Learning (DL) have made substantial improvements to the way we live and work, see Fig.1. These advancements have allowed the analysis of large amount of data in a short time compared to what people are able to do [1]. Artificial Intelligence can change the whole World by using these amounts of data [2].
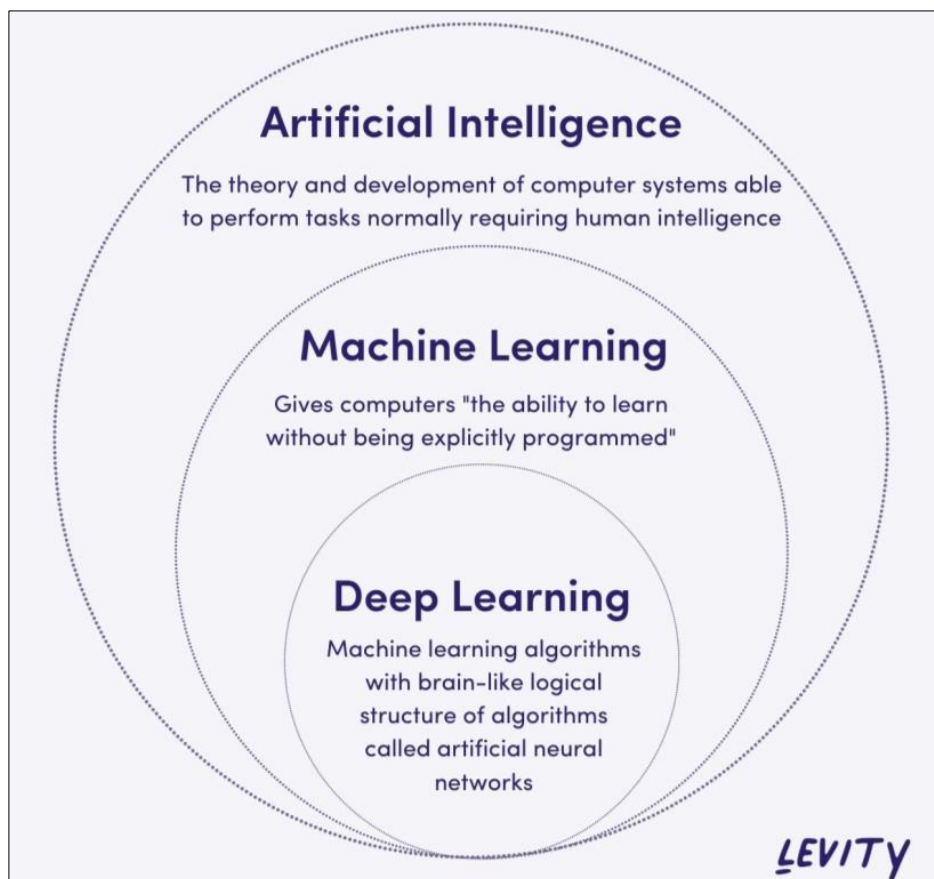

Fig. 1. Difference Between Artificial Intelligence, Machine Learning, and Deep Learning. Source: https://levity.ai/blog/difference-machine-learning-deep-learning

1.1. Background

According to John McCarthy, the American computer scientist and founder of the discipline of Artificial Intelligence, AI is *"The science and engineering of making intelligent machines, especially intelligent computer programs"* [2]. The most common description of Artificial Intelligence, that it is a method of achieving complex targets in complex environments [3]. AI is a technique of making a software or a computer think and behave as intelligently as humans do. AI studies how the brain of human thinks, learns, decides, acts, and works during the process of solving a problem. Then, AI utilizes the results of this study as a base for accomplishing the intelligent systems [2].

In the last 60 years, Artificial Intelligence has been supplemented by related sub-fields such as Machine Learning, Neural Networks, Speech Processing, and many others [4]. The concept of AI was science fiction, like Aliens, but with the development of Computer Science field, AI shifted from being associated with Sci-Fi. The concept of AI has been changed because of the fast evolution of technology, also, after learning more about the human mind mechanism. Now, AI focuses on mimicking the human behavior, rather than running out complex calculations [2].

Artificial Intelligence has got its way in many sections, developed from defeating World champion chess players to identifying human faces. The capabilities of AI are endless into the Architecture field (design, management, construction, real estate, urban planning, etc.), but not yet fully exploited [1]. AI has the possibility to change the whole discipline giving it new paths to explore. It became a crucial aspect to change the way we think about the design process for creating Architecture [3]. Today, most of the used technologies are not completely artificially intelligent because they still need the human involvement to do the most important part of the whole task [2].

In the early 1960s, the progress of drawing tools had become more advanced since the release of digital tools such as CAD and CAAD. In the meantime, there is a necessity for exploring how AI can affect creativity in the design process [1]. In some cases, architects tend to use AI in the design process with its different advantages and disadvantages to fit their specific demands [3]. Nowadays, most of the researchers are working on the applications of AI to Architectural design, a few design software permits using ML algorithms. Some architectural companies have started putting DL methods into practice with an interest in building performance and environmental sustainability. It is essential to understand the role of this new technology within the architectural design process, taking into consideration the scope of a complex profession like the architect. It is no doubt that AI technology will be highly useful for the professional practice over the next upcoming years [4].

1.2. Purpose

The purpose of this paper is to explore the effect of Artificial Intelligence on the design phase and creativity in Architecture process. The paper will study the impact of Artificial Intelligence on the Architect`s profession. Moreover, the research question is *"Can AI replace or delete the Architect? Or Will AI improve the job description of Architect?"*

1.3. Relevance

The literature study was performed to understand the application of Artificial Intelligence in Architecture and Construction fields. AI is a partial concept of Digital Construction that is subjected to make the construction process safer and more productive. AI has a great intent to develop the construction industry in several ways as it has already done in the last few years [5]. AI is assumed to play a great role in Architecture and Construction fields as it enables massive amounts of data processing which can offer a great number of simulation possibilities for architects [1]. AI can improve design output, draw buildings with respect to the building's codes, cost, and size constraints. AI can do risk scenarios and recommend solutions to lessen them [5]. Some researchers see the generative design tool as a supporting tool for creativity because it allows the designer to generate and explore many design alternatives in the early stage of design process [6]. Also, AI can design with concern to the human or vehicles movement patterns. It can design buildings in relation to heat radiation, light input, and noise exposure. This can alter the design to the best optimization of energy usage. It can create buildings with a futuristic look, as shown in Fig.2, which are shaped by the environment they are built in [1].

The updated automated design systems are used in the contemporary Architecture because they can facilitate the freedom of modifications and increase productivity, with respecting to the customers` demands [3]. AI adds value to the design, as AI can track the requirements and parameters of customers, which might change the design form. AI can perform quick and varied design simulations to show customers how the design can be changed to achieve the customer's best needs. When the design is created with respect to clients` needs, it means creating value to the design [1]. AI will try to solve problems such as efficiency and optimization that faced the Construction and Architecture field many years ago. Architecture design is a distinct field of a special character. The design should satisfy the demands of society such as new housing needs, recreational areas, transportation, work areas, schools, etc. Those areas should be designed to be safe when walking with concern to the environment, and sustainability [1].

Thus, it is required to develop new techniques and tools to be used comfortably to create new design innovations. Artificial Intelligence is still hard to be used correctly in Construction and Architecture field. AI tools are focused on saving money, but they should focus on creating design value for users. The first challenging step is to figure out how to use the digital tools for creating value, then saving money in the long run.

Fig. 2. AI design proposals when an architect asked AI software to design skyscrapers in the future city.

Source: https://edition.cnn.com/style/article/ai-architecture-manas-bhatia/index.html

2. Understanding the effect of AI Application on Architecture

Data-based systems should be instantaneously developed to adapt with the huge amount of documentation data to be generated due to construction process, taking into consideration the complexity of the architectural design process. Regarding AI technology, architectural design should be considered as data processing to reach the best possible computing outcomes [3]. Therefore, the paper focuses on Architectural design generally and the creativity of architects in designing physical and virtual structures that affect peoples' everyday life. The shape of any structure has many impacts on the whole Architecture and Construction industry such as cost, material use, energy use, light, and noise exposure.

2.1. Capabilities of AI in Architectural Fields

2.1.1. In Design Process

Artificial Intelligence can do a good job in the process of design, as it can simulate many design alternatives in a short time. Simulation is very helpful in the design phase as architects need inspiration from exploring many options where inspiration is considered as a key element in the creativity process. AI processes a huge amount of data so it can keep and check all the required parameters such as material use, energy use, light exposure, and noise exposure. Those parameters take much of the time in the design process but having many design alternatives can shorten the time of this process. It is considered a difficult task for AI to sort and choose between many design alternatives because this stage is dependent on architect`s experience [1]. Traditional design process depends on 2D drawings which are plans, elevations, and sections but the new technologies integrated more 3D modelling into the design process. BIM extends from 3D spatial dimensions to integrate time (4D) and cost (5D) to the design. Also, new dimensions are added like environmental analysis (6D) and life-cycle management (7D) [2].

2.1.2. In Construction

In mega-scale projects, the predictive models for cost and time plan, generated by AI application, can eliminate the cost overruns. Also, AI can monitor jobs and risks on site, so subcontractors are evaluated for less risk by a machine learning agent. For instance, robots can routinely take 3D images, accumulate site assessments, and create fast and precise reports that can be automatically linked to the plan of a project; thus, to save time, money, and labor. Moreover, robots could be trained to accomplish repetitive tasks such as excavation, brick assembling, concrete pouring, bar bending, welding, etc. Precast structures such as beams, columns, slabs, walls, claddings, and HVAC systems, can be assembled by robots in factories and then cast by human on site [2]. AI can improve the worksite safety by simulating workplace scenarios of managing different construction parts, also simulating new forms that could be much easier to carry and control [1].

2.1.3. In Material Selection

Today, the processes of energy and material optimizations take a lot of time because of the extensive calculations and repeated modifications in the design. When AI is applied for these steps, it saves time and makes obvious improvements for the final product [1]. The target of optimization is to minimize the use of materials which will affect the energy demand and project expenses during the construction process [3]. The application of AI with 3D printing, together they can create new shapes and forms that demand less material and use fewer resources. This can help the architects in their creative process to create non-standardized shapes [1]. AI gives the architects more data to design more solutions with less material demand. Also, it helps them to design buildings more efficiently in space so that less meters` usage is wasted [1]. In general, AI will play an important role in the optimization of material use and waste.

2.1.4. In Smart Cities

The development of AI will develop our cities to be smart ones [2]. A Smart city is an urban area that utilizes several types of automated Internet of Things (IoT) sensors to accumulate data then use them to operate assets and resources effectively as shown in Fig.3. It analyses the accumulated data from citizens, devices, and assets to monitor and manage traffic and transportation systems, power plants, water supply and networks, waste management, crime detection, and information systems of schools, libraries, and hospitals [7]. Smart city technology helps to explore safety risks to residents, minimize crime and violence, and track weather data [8]. A smart city can be a place driven by real time feedback; it can communicate with itself like a living organism. Buildings, public spaces, cars, and smart phones will connect with each other to enhance living circumstances. The smart home, just like the smart city, is a complex living data organism. The smart home automation system controls climate, lighting, appliances, security, and alarm systems. AI in architecture is a user-friendly tool and helps in most of daily life tasks [2].

Fig. 3. Application of IoT in Smart City [9].

2.1.5. In Parametric Design

Parametric design is a design system that permits you to work with parameters to generate different types of outputs. It is a tool that allows the architect to choose his design output, set the constraints, and create unlimited iterations of building within few minutes [8]. AI can automatically access data and transform it into parameters, so it is able to simulate, analyze, and compare design alternatives. The required quantitative data can be accessed by sensors and processed through Deep Learning such as; climate, topography, land use, site, and numeric data (number of floors, stairs, rooms,etc). AI can use this data and transform it into parameters to introduce a design [2].

2.1.6. In Environmental Solutions

Machines that learn by obtaining knowledge and do tasks like humans can offer possibility for the development of solutions. AI can help in reducing the extreme use of natural resources, thus will enhance environmental governance for a sustainable healthy living. AI can offer new chances to conquer the huge environmental challenges. For instance, AI can suggest data-driven interventions and strategies to make progress in mitigating climate change [10]. AI can operate strong predictive opportunities and smart grid systems towards managing the renewable energy usage. The accurate weather forecasts can optimize energy efficiency and decrease carbon pollution generation so it can improve energy storage and load management [11]. Furthermore, there is an obvious role of AI in transforming vehicles into Electric Vehicles (EVs) which have a direct benefit on the environment. Greenhouse Gas (GHG) emissions produced by cars are the most harmful source of climate change, also they are well-known for their huge negative impacts on human health. The Environmental Protection Agency (EPA) states that a fully EV has zero harmful emissions on health and environment. AI can gather data from vehicles, sensors, and cameras so that pollution sources

can be detected much earlier than before, and air pollution elimination could be improved [1]. Now, there is an integrated AI system called air purifiers that can record air quality and environmental data in real-time and adjust the efficiency of air filtration. Moreover, AI technology can send warnings to people regarding their level of pollution in their urban areas [11]. Generally, AI will play a significant role in the environmental sustainability aspect.

2.2. How can AI change the role of Architect in Architectural Design Process?

In future, it is possible that AI can replace Architects in the design stage, if the industry still focuses on making money only, not creating value. So that Architects have a big challenge to prove that their experience and knowledge are valuable and could not be replaced by robots or AI technology [1]. Several researchers are worried about the introduction of AI technology in Architecture field, it will bring enormous modifications to Architecture [4]. The introduction of new technology always puts pressure on both designers and users. For example, designers need to do their jobs with tools they are not relaxed with, this leads to limiting their creativity. Designers can react in different two ways, either with an open mind and eager to learn, or others who completely do not have the ambition to learn new things. In contrary, AI is seen as a tool to help the architects by getting more data from society into drawing and planning tools to create more evidence-based design fulfilling the set of demands [1].

Indeed, the role of Architect will be altered with the help of Artificial Intelligence. In the future, AI can generate fast mass production and Architects will only set the limitations and filter the scheme according to customer and market demands, The agent in AI can control the design and give it an obligatory direction like government regulations, styles, layout, and environment [2]. AI can generate many creative design solutions, but it is complicated for the computer to judge the results and differentiate between the good and bad ones. There are two phases of evaluation; the objective logic which is based on mechanical laws and the subjective one which is based on culture and aesthetics. The objective one can be evaluated by a computer as there are strict laws of mechanics, but the subjective experience judgement needs human intervention first. The results can be added to an AI machine then a database of many evaluations can be built and later, by applying AI algorithms can create an AI judging tool [12]. Consequently, designers should accept that there are significant differences between the previous digital techniques and these new AI methods implemented in Architecture. To adopt these developed technologies, higher power computer systems and workstations are needed compared to common computers [4].

No doubt that the advanced AI design systems can learn design behaviors based on the Architect`s projects, but the role of Architect is still vital to choose the most suitable solution from numerous computed alternatives [3]. In these cases, it is still too early to say that AI will delete the profession of Architects, they have the right to control the design process at any stage, selecting alternatives, and asking questions supposed to be answered by Artificial Intelligence [4]. The position of designers is always vital because they are responsible for balancing between the significance of different factors in the form creation process [3]. In the immediate future, the job of AI will be an assistant to Architect, and it can be able to solve specific problems defined by the Architect [4]. Therefore, these advanced AI

systems cannot replace humans as designers/architects, they can help in creating variable solutions, but they cannot take the final decisions. The aspiration of Architects towards creativity and controlling design environment is endless [3].

2.3. Limitations of AI in Architecture

The most essential part of the design process is creativity and many design factors are affected by the creativity. According to Oxford Advanced Learner's Dictionary, creativity is defined as *"The use of skill and imagination to produce something new or to produce art"* [13]. The Oxford definition of the word *"Creativity"* is simple and straightforward definition. Since then, many researchers have created models to understand the complexity of the creativity concept. Creativity is an intentional process and an individual ability that happens in a particular environment, and includes creating something novel and useful, it should achieve them both and together [1].

In the creativity process, AI can serve as an assistant tool for preparation because of its ability to analyze and visualize enormous data [1]. Researchers realized that the limitations of AI in creative work are apparent. AI learns from data inputs so any inaccuracies in the data will be reflected in the results. AI can do a well-defined task, for example a system that plays Solitaire cannot play Chess [12]. Therefore, AI can help human to recognize the World quickly and predict the probabilities on this base, but it still cannot create an innovative thinking regarding Architecture field [2]. For instance, if a designer shows an AI system a modernist Architecture, AI will only create modern Architecture choices [4]. This is because Architecture is the most complicated practice, and any Architecture choice involves limitless attributes. Architecture is not a practice of a specific question carrying out a single answer or choice correctly. Architecture process hold many parameters from which the design choices arise like human, politics, social sciences, engineering constraints, environmental parameters, and art [4].

Previous researchers see that AI-generated buildings lack soul because AI can create walls, roofs, doors, and windows; as those parts can be defined by rules and codes, but the soul of buildings can only be created by the practices and perceptions of Architects. This kind of data is hard to be captured by AI, as intuition cannot be transferred into codes particularly for unique buildings where there are limited data samples [1]. The transmission of knowledge and intuition that characterizes humans is a hard challenge to AI to overcome it. AI is smart but it cannot achieve the soul of buildings by itself. The soul can be achieved when Architect and Customer are involved in the design process together, understanding the possibilities and involving the design parameters in line with the market demands.

Generally, AI-generated buildings are somewhat far away from the industry, as there are still problems with converting experiences and intuitions from architects into codes. AI can generate buildings but probably the public cannot accept to live or work there. AI has its place in the design process in many aspects like energy optimization, material optimization, and parameter control regarding building requirements and customer demands [1]. It is still important to consider the creativity in the development of AI products, there is much space for creation something new and useful [14].

3. Methodology

To understand the capabilities of using Artificial Intelligence methods within the design process, a suitable methodology is conducted for this study as shown in Fig.4. The methodology used in this paper is consisted of four phases: (1) A comprehensive document study of the available and relevant literature, (2) A questionnaire contains appropriate questions for professionals in architecture field, (3) An analysis of the materials produced from the answers of the questionnaires, (4) A comprehensive conclusion connecting between the literature and the answers of the questionnaires.

A questionnaire sheet is prepared for professionals in Architecture field, see Appendix A. The questionnaire begins with a simple introduction informing the participants about Artificial Intelligence and the aim of the research. The next section includes general questions about name, age, and profession. Then, it contains some questions about their knowledge about Artificial Intelligence, its capabilities in the design process, and the expected obstacles facing AI in Architecture. Finally, it asks about their expectation about the role of Architects within AI in the design process and if AI can replace the Architect or alter his role. The targeted contributors had a variety of socioeconomic characteristics. The sample consists of professional Architects either with academic or non-academic professions, private jobs, or free-lancers with different Architectural backgrounds. The survey targeted 50 professional Architects, and 42 gave valid feedback and responses. The participants are mostly between the ages of 20 to 40 and some are above 50 years old.
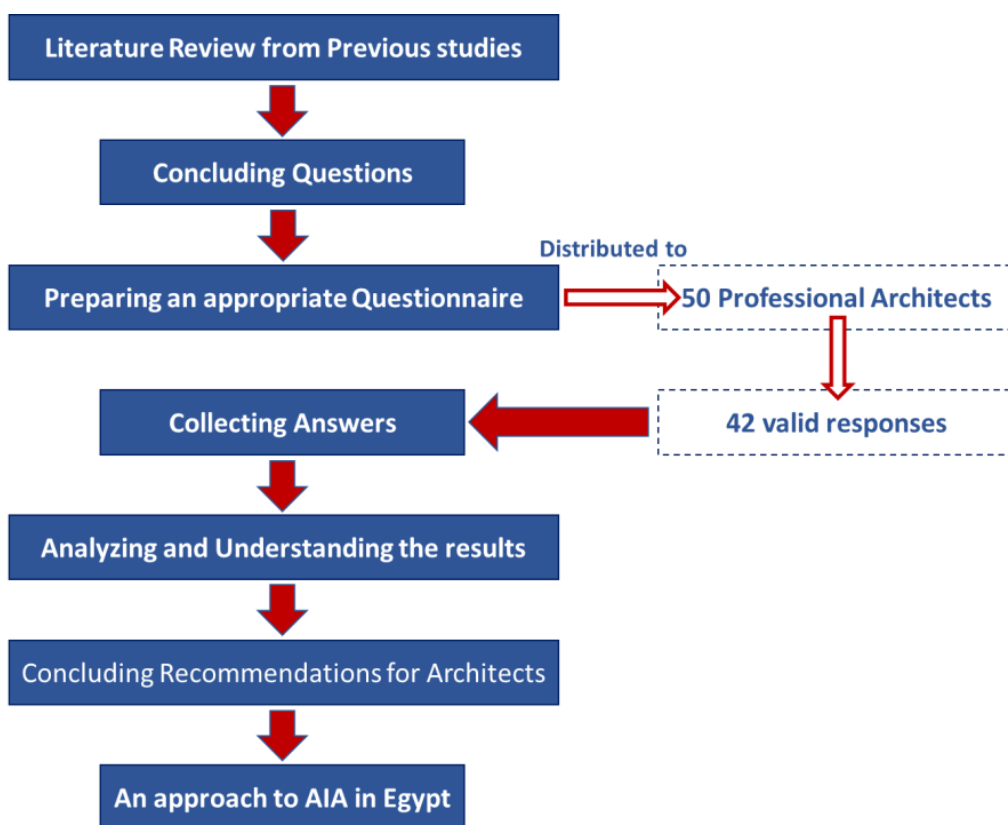

Fig. 4. The Research Methodology.
Source: (The Researcher).

4. Results and Discussions

The results are based on the materials of a questionnaire done with some professional Architects in addition to the previous literature review. The results were collected and analyzed to make a comprehensive understanding of the possibilities of applying Artificial Intelligence in Architecture especially, in Egypt.

The age of respondents varies between 20 to 50 and above 50 years old, 45% aged from 20-30, approximately 28% are 30-40, and 7% above 50 years old. Most of the participants (78%) are in an academic profession, and only 10% of them have a private job. Fortunately, all the contributors are familiar with the term "Artificial Intelligence". Despite that 64 % of them refer to previous projects that were done by AI techniques, and the others did not see any previous AI projects done before. Only 24% of the participants have used AI technologies in the design process.

Most of the participants (62%) think that AI can be used effectively in Exhibitions and Museums projects as shown in Fig.5. Administrative and Health-care buildings come in the second place (55%) followed by Airports (52%). Then, AI can help in designing Residential and Educational buildings (47%). Some participants add the items of Heritage projects and Urban Design projects to the answers in the questionnaire. Only about 2% of the respondents recommend that AI techniques can help in all types of buildings.
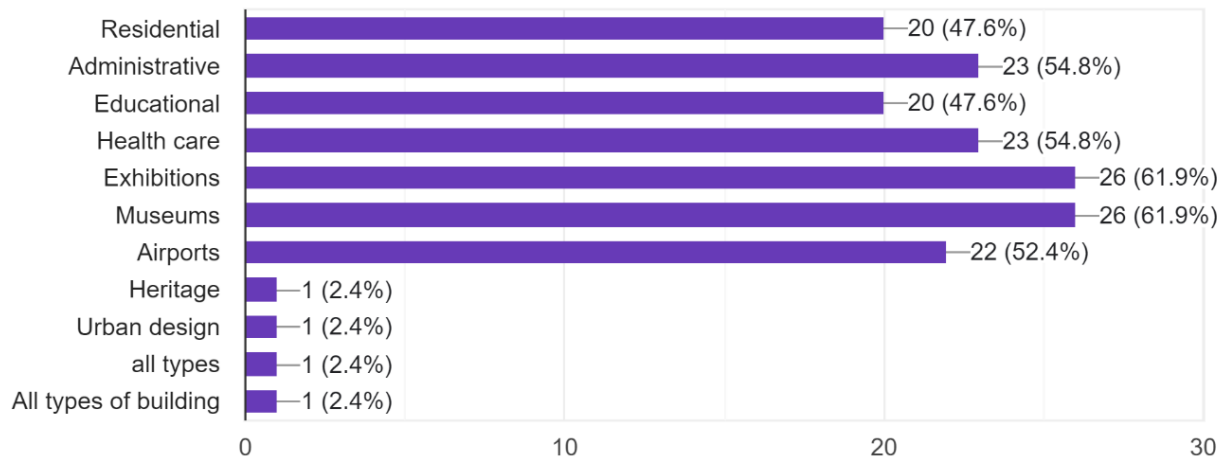

Fig. 5. Results of the question "Which type of projects can Artificial Intelligence help in the design process?"

We asked the participants about the phases that AI can be implemented in the design process. Approximately 60% of them think that AI can be involved in the phases of concept generation and schematic design then comes brainstorming and design alternatives stages as shown in Fig.6. 19 respondents see that AI can be effective in design development phase. Only 28% think that AI can be implemented in the evaluation step.
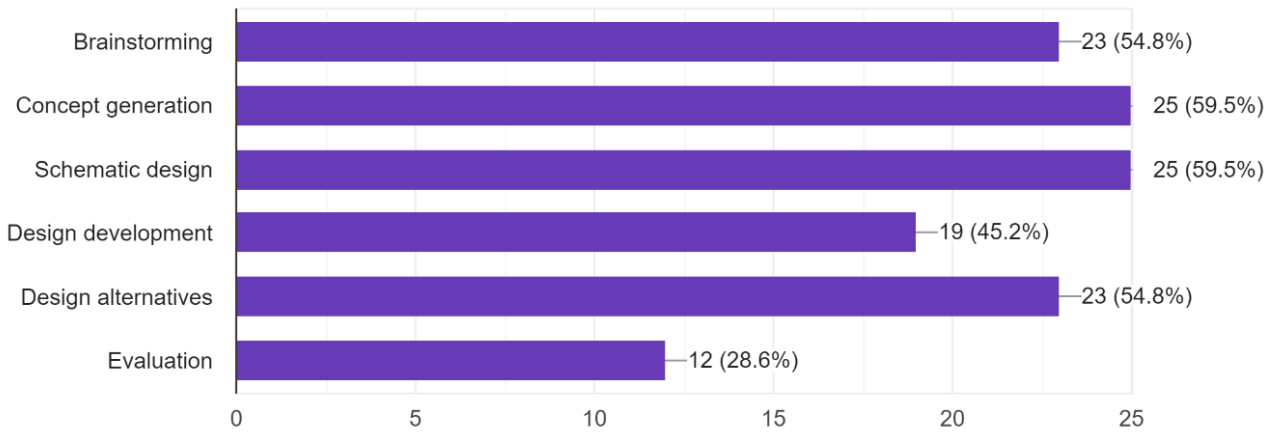
Fig. 6. Results of the question "In which phases do Artificial Intelligence can be implemented in the design process?"

Application of AI in Architecture faces some obstacles like any new technology. Most of the participants expect that the implementation phase will be the biggest obstacle in the way of AI application as shown in Fig.7. Some of the respondents think that it is difficult for AI to cope with creativity and decision making in Architectural design process. Only 14% see that the evaluation process is the main difficulty in AI involvement. One architect added that maybe we will face unexpected results from AI application in the design process.
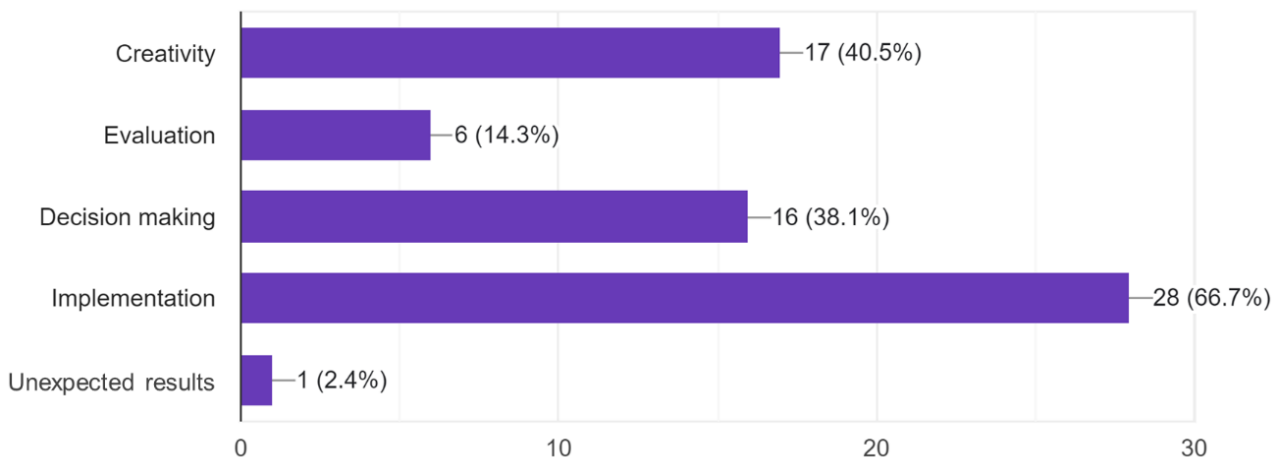

Fig. 7. Results of the question "What are the obstacles/difficulties that face AI in Architectural design phases?"

From the previous literature, we concluded that AI can be involved in many aspects, so we asked the professional Architects about their opinion in 4 main aspects as shown in Fig.8. Around 76% of them think that design process is the most important aspect that AI can be involved in. While 25 respondents see that energy use is a substantial aspect. The construction phase and material selection come in the last place from the professionals' point of view.
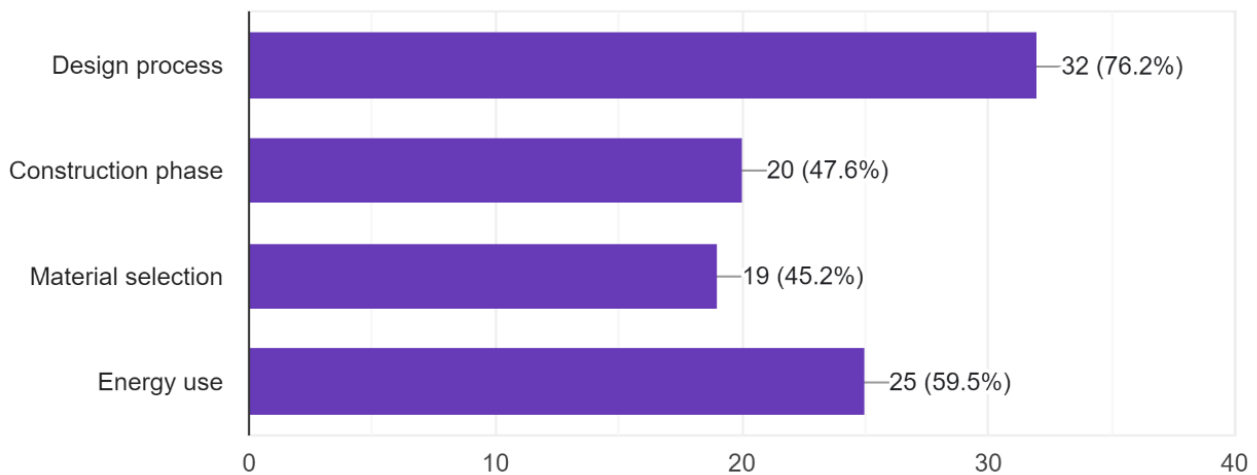
Fig. 8. Results of the question "Which of the following aspects can Artificial Intelligence be involved in?"

The creativity process is an essential and a distinguishing factor in the design process. Most of the participants (74%) think that AI will have a positive effect on the creativity process on contrary to about 17% think that AI will reduce the creativity process. Others see that AI will have no obvious effect on the creativity process. Some professionals are convinced that humans are more creative than AI driven tools, others added that the effect of AI depends on how we use it.

The successful building is the one who has a significant soul. From the previous literature, we realized that many researchers are worrying about the relation between AI tools and soul of buildings. When we asked the professional Architects, half of them thought that AI generated buildings will lose their soul. Approximately 40% of the participants see that buildings will keep their soul. Others added that buildings may lose or keep their soul depending on the design itself and how AI technology is applied.

Architects should accept the application of new AI technology in Architecture, also they should expect the obstacles that may face AI in the implementation step. Therefore, we asked the professionals, and most of them (67%) confirmed that the implementation process on site will be difficult and challenging. 22 respondents recommend that creating new methods of implementation will be a must to face the obstacles of implementation as shown in Fig.9. Some of the participants (45%) think that the step of creating working drawings will be an obstacle. 13 respondents consider that AI application will cause waste in materials use while 8 of them see that it will cause waste in energy use. Finally, 9 participants think that Architects should be familiar with new printing techniques (like 3D printing) to cope with AI in the implementation step.
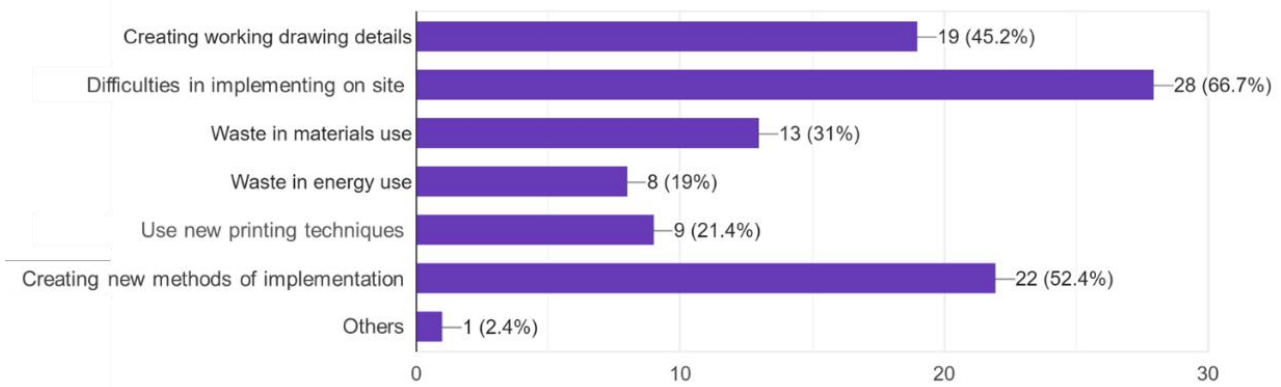
Fig. 9. Results of the question "In your opinion, what are the obstacles that will face AI in the implementation step?"

After that, the questionnaire asked if Architects worry about their job in the next years within the era of AI. 29% of them are worried about losing their job while 33% feel safe in their positions, but 38% cannot be accurate about their expectations towards AI. It is promising that most of the participants (81%) have passion towards learning new AI design techniques in Architecture. Only 5% of them do not have the motives towards learning new methods. 14% of the respondents are not sure yet about their ambition towards learning new AI techniques.

Most of the participants (71%) think that AI will replace Architects. At the same time, 28 professional Architects see that they can keep their primary role within the era of AI. While 14 respondents think that the Architect`s role will be a secondary one. 60% of the participants see that they can keep their creativity in AI-driven design process. Also, we asked about their expectation towards the customer`s acceptance of new AI design tools. 38% of them think that they will accept the new technology while 57% are not sure about their acceptance.

Eventually, we need to know how to involve AI techniques effectively in Architectural design, so we asked the professional Architects about the precise role of AI in the design process as shown in Fig.10. 31 respondents see that AI can be only an assist tool while 20 think that AI can be a design tool too. Approximately 33% of the participants expect that AI can be an evaluation tool. Only 9 respondents think that AI can serve as a decision maker tool.
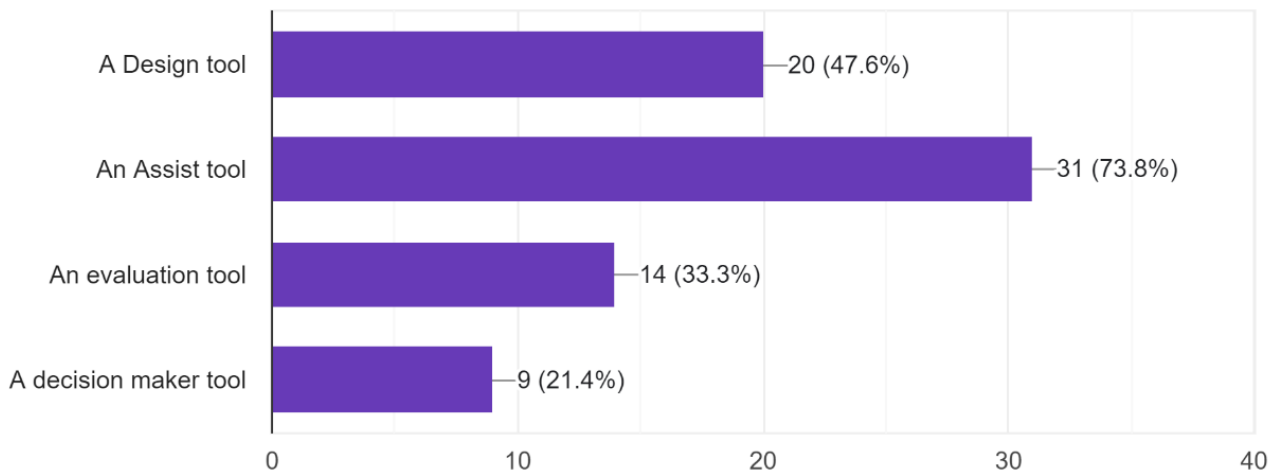
Fig. 10. Results of the question "What will be the role of Artificial Intelligence in Architectural design?"

5. Conclusion

We can point out that Artificial Intelligence can enhance the efficiency of the design process. Nevertheless, there is still a persistent need for designer`s evaluation, decisions, and controlling of every step of any project. Therefore, AI-driven tools can be used as assist tools to the design process. Questions about replacing Architects with Artificial Intelligence are still occurring but, in fact, the primary role in the design process will be the task of the Architect. AI will not replace or kill the Architect, but it will improve his work. Fortunately, the result of the study proves that contemporary Architects have ambition towards learning new AI design tools. AI will replace an Architect who does not use AI-driven tools in some phases of Architectural field. AI can be used as an assist tool in the design process but there are still some difficulties facing the implementation phase. However, AI has a considerable role in concept generation and schematic design, but it cannot serve as an evaluation or decision maker tool, these aspects are human brain task. So, Architect`s job description can be altered in the future, but it cannot be deleted. Architects should learn and cope with the new AI technologies to keep their position. For our future research, some case studies will be analyzed, and an evaluation comparison will be done to AI-generated buildings with traditional buildings, taking into consideration the results of the current study.

Acknowledgement

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Appendix

Questionnaire about Artificial Intelligence in Architecture

Artificial Intelligence (AI) is a fast-emerging field and is becoming an essential part of our future. Recently, AI has a significant impact on multiple fields and industries, like IT, cybersecurity, medicine, and manufacturing since it provides them with countless creative opportunities. Compared to the mentioned fields, the development of AI in architecture is still not commonly used. Therefore, this questionnaire is being held to understand the opportunities of AI methods within design process and how AI techniques can affect the architect's attitude to the design.

* Required

General Information
Please answer the following questions about yourself

1. Name

   _____

2. Age *

   Mark only one oval.

   ◯ 20-30
   ◯ 30-40
   ◯ 40-50
   ◯ Above 50

3. Your current Profession *

   Mark only one oval.

   ◯ Academic
   ◯ Non-academic
   ◯ Private job
   ◯ Freelancer
   ◯ Other: _____

Role of Artificial Intelligence (AI) in Architecture
Please tell us your opinion about AI application in Architecture

4. Are you familiar with the term "Artificial Intelligence"? Have you heard about it before? *

   Mark only one oval.

   ◯ Yes
   ◯ No
   ◯ Not sure

5. Have you seen any previous design projects done by Artificial Intelligence techniques? *

   Mark only one oval.

   ◯ Yes
   ◯ No
   ◯ Maybe

6. Did you use Artificial Intelligence techniques before in your design process? *

   Mark only one oval.

   ◯ Yes
   ◯ No

7. Which type of projects can Artificial Intelligence help in the design process? *

   Check all that apply.

   ☐ Residential
   ☐ Administrative
   ☐ Educational
   ☐ Health care
   ☐ Exhibitions
   ☐ Museums
   ☐ Airports
   ☐ Other: _____

8. In which phases do Artificial Intelligence can be implemented in the design process? *

   Check all that apply.

   ☐ Brainstorming
   ☐ Concept generation
   ☐ Schematic design
   ☐ Design development
   ☐ Design alternatives
   ☐ Evaluation
   ☐ Other: _____

9. What are the obstacles/difficulties that face AI in architectural design phases? *

   Check all that apply.

   ☐ Creativity
   ☐ Evaluation
   ☐ Decision making
   ☐ Implementation
   ☐ Other: _____

10. Which of the following aspects can Artificial Intelligence be involved in? *

    Check all that apply.

    ☐ Design process
    ☐ Construction phase
    ☐ Material selection
    ☐ Energy use
    ☐ Other: _____

11. How does Artificial Intelligence affect the creativity process? *

    Mark only one oval.

    ◯ Good / Positive effect
    ◯ Bad / Negative effect
    ◯ No effect
    ◯ Other: _____

12. Do you expect that Buildings with AI driven tools will keep or lose their soul? *

Mark only one oval.

◯ Keep soul

◯ Lose soul

◯ Other: _____

13. In your opinion, what are the obstacles that will face AI in the implementation step? *

Check all that apply.

☐ Creating working drawing details
☐ Difficulties in implementing in reality
☐ Waste in materials use
☐ Waste in energy use
☐ Use new printing techniques (such as 3D printing)
☐ Creating new methods of implementation

☐ Other: _____

14. As an architect, are you worrying about your job within the upcoming years? *

Mark only one oval.

◯ Yes

◯ No

◯ Maybe

19. What will be the role of Artificial Intelligence in Architectural design? *

Check all that apply.

☐ A Design tool
☐ An Assist tool
☐ An evaluation tool
☐ A decision maker tool

☐ Other: _____

20. Will the customer accept the new AI design building? *

Mark only one oval.

◯ Yes

◯ No

◯ Maybe

15. Do you have passion towards learning new AI design techniques in Architecture? *

Mark only one oval.

◯ Yes

◯ No

◯ Maybe

16. Do you think, can Artificial Intelligence replace Architects? *

Mark only one oval.

◯ Yes

◯ No

◯ Maybe

17. What will be the role type of architects within the era of AI? *

Mark only one oval.

◯ Primary role

◯ Secondary role

◯ No role

◯ Other: _____

18. Can the architect keep his creativity in AI-driven design? *

Mark only one oval.

◯ Yes, he can

◯ No, he cannot

◯ May be

◯ Other: _____