Artificial Intelligence's Effects on the Profession of Architecture and Architects' Prospects

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ABSTRACT

AI is a rapidly developing field that will become a vital component of our future. Recently, most employed technologies are somewhat artificially intelligent, but most of the task still need human input. In comparison to disciplines such as IT, cybersecurity, and health, AI progress in architecture is still in its early stages. The prevailing notion in architecture is that intelligent robots will take the role of designers in the creation of works of art and architectural structures. However, only humans continue to have access to the outputs of open-ended creative processes. AI can do countless activities involved in the design of buildings that require human intelligence, such as making decisions. Therefore, it is essential to comprehend the function, benefits, and drawbacks of this technology inside the design process from a professional standpoint. As a result, a survey will be sent to several professional designers, architects, and researchers. A summary of their results will subsequently be included in this page. The objective is to understand how AI methods can impact the architect's perspective on the design process. Some large architectural firms have started experimenting with deep learning methods to put data gathered over years of profession into practice, with a special interest in environmental sustainability and building performance. Many researchers are working on artificial intelligence applications to architectural design. The next step, in our opinion, is to comprehend the potential functions of this technology inside the architectural design process as well as the extents to which they may support a profession as complicated as architecture. In the article, we will summaries their testimonies, compare and discuss the designer's responses to understand the potential uses of artificial intelligence techniques in the design process, and report their opinions on how these techniques may affect the approach to the project taken by the architect. We will then conclude with some reflections on the important issues discovered during the interviews with the designers.

Keywords-- Artificial Intelligence, Architect's Role, Questionnaire, Architectural Design, Digital Architecture, Creativity, Digital Design, Design Creativity

I. INTRODUCTION

The advancement of computing technologies has played a major role in meeting daily necessities. As artificial intelligence advances, machines can now process, analyze, reply, and create just like humans. These machines are moving beyond machine-like capabilities. The way we work and communicate with each other has changed significantly over the past century thanks to the development of digital tools and the rise of highly technological innovations like artificial intelligence (AI), machine learning (ML), the internet of things (IoT), and digital twins. (K., 2015) More data can now be consumed and analyzed quickly than any human could have ever imagined because to these developments. AI computers are now excelling in a variety of professional sectors that involve intelligence, creativity, and critical thinking, such as architecture. Many arguments regarding the future of architectural practice revolve around the prospect of computerized architects taking over the professions of real architects. Architecture and its practitioners are involved in the emerging realm of artificial intelligence, and its future is being researched. This may cause some to wonder what role artificial intelligence will play in our world moving forward. Architects will have to overcome the difficulty of rapidly incorporating the evolving technology breakthroughs into the creative design process in order to produce more notable results for everybody.

People are apprehensive about being replaced by non-intelligent machines now, so it stands to reason that they will be even more concerned when intelligent machines such as AI begin to surpass humans at work in many ways. As it becomes clear that humans and AI will have to cohabit, the question of who will make business choices will become increasingly important.

Meanwhile, we may examine the impact of AI implementation on human characteristics like creativity, which this article will examine from an architectural perspective. The effects AI has on creativity become

interesting since creativity is a very complicated human attribute with many components at play, and creativity plays a large role in design thinking. Since the advent of digital tools like CAD and CAAD in the early 1960s, drawing tool development has become increasingly sophisticated. (Csikszentmihalyi, 1988) As a result, research into how emerging technologies like AI may impact the creative design process is necessary. Not only is it a relatively new technology, but it also poses a challenge to more sophisticated human qualities like creativity.



Figure 1: Design methodology within the framework of conventional human-intensive operational models Source: Author



Figure 2: Design practice and problem-solving loop Source: Author

Artificial intelligence (AI) is the intelligent machine version that humans create, and the AI machines that are currently on the market have a limited capacity for creativity as opposed to the infinite creativity of the human brain. Several concerns would arise if we were to envision a society in which artificial intelligence replaced most jobs. Since most businesses will eventually adopt AI machines, leaving no room for individuals to generate their own money and success, humans are no longer able to fulfil their dreams, which can have a negative impact on mental health. Everyone will remain at home, and there will not be any communication.

AI should be altering architecture practice by making everything smart in the future, enabling many new possibilities that were not before feasible. AI should be doing things that humans cannot do, such as astrological discoveries and more. This means that AI will continue to evolve, and who knows what new opportunities those advancements will bring us and to the table of architecture. As a result, AI could potentially progress as a creative designer in the future, perhaps even stronger in the creative field, but automated hi-tech machines can never create sensible spaces that communicate within humane understanding of a space, and that is what architecture is all about.

II. PURPOSE

The goal of this article is to investigate the impact of AI on the design phase and creativity in the architectural process. The purpose of this research is to investigate the impact of artificial intelligence on the profession of architect. In addition, the study topic is "Can AI replace or eliminate the Architect?" Will AI enhance the job description for an architect, instead?

The paper is exploratory and will utilize semistructured interviews to answer the research question that is: What place does AI have in the design process, and how does it affect the creative process?

It sparks a discussion about the advantages and disadvantages of how AI can advance the practice of architecture. AI offers prospects for future advancements in architecture and the rest of the world by enabling better design outcomes, a speedier design process, and appropriate solutions. In conclusion, the results are uncertain because the outcomes are still unknown. AI is less likely to replace architects, according to research, and in terms of architectural practice, it will offer new techniques that adapt to people's future wants.

2

III. FRAMEWORK

The creative process is primarily concerned with the process by which a person is confronted with questions and difficulties and what causes them to come up with original ideas and answers. One can wonder how their mental processes are structured and whether creative people use comparable thought processes to develop novel ideas and solutions. There is still debate on whether creative people have comparable thought processes, yet some people believe that creativity can be taught. The creative process can be derived from The Art of Thought by Graham Walls, published in 1926, which consists of the four steps of the creative process: preparation, incubation, inspiration, and verification. Rhodes approached the question of what creativity is by dissecting the word into the four Ps. His answer was:

"The word creativity is a noun naming the phenomenon in which a person communicates a new concept (which is the product). Mental activity (or mental process) is implicit in the definition, and of course, no one could conceive of a person living or operating in a vacuum, so the term press is also implicit" (Rhodes, 1961)

Rhodes (1961, p 308) defines press as the relationship between humans and their surroundings. Environments are the physical and social conditions that a person or creative process is subjected to. Environments can be supportive or constricting in nature. Without actively influencing the creative product, they serve as moderators to the factors of the creative process and individual. These social contexts include educational settings, natural surrounds, job environments, familial upbringing, and cultural customs. It is critical to understand that individuals experience their surroundings differently, generate ideas from perceptions, imagination, and sensations, and operate differently in diverse situations. The environments that people are exposed to serve as a mirror of the ideas that they generate since these influences serve as the basis for the formation of original concepts. (Margolin, 1996) People frequently face deadlines in a variety of contexts, including job, school, and social settings, making time a social press. While some people are driven by strict deadlines and high-pressure situations, others like to take their time and flourish in creative circumstances without any constraints. Education is one of the most important contexts where it might be challenging to foster innovation and creativity. Human cognition generates ideas, which are subsequently conveyed to others in a variety of ways. They can be expressed in many ways, such as words, paint, wood, metal, stone, inventions, patents, performances, and many more. They are the result of thought.

IV. METHOD

Research Question's:

1. If artificial intelligence is used in architecture, what would be the future of that field? & How does the involvement of artificial intelligence affect the work of architects?

2. AI and the practice of design: How much will AI likely alter the field of design? Does AI-induced context change affect the design process and the goals of design actions?

3. AI and design principles: If AI significantly alters design practice, would these modifications go so far as to call into question fundamental design principles like user centeredness? In the era of artificial intelligence, are design practices guided by radically new principles?

4. What effects does the theory of design have on the theoretical frameworks that we apply to understand design? Is it necessary to ask new research questions in the era of artificial intelligence and to reexamine how design influences innovation in businesses?

What role does artificial intelligence play in design, and how does it impact the creative process? The inspiration for the research question came from being in awe of architects' inventiveness in creating both real and virtual items and buildings that move and have an impact on people's daily life. How they negotiate the intricate AEC market and come up with original solutions to the sector's arising and present issues by changing the design. (Haenlein, 2019) Every facet of the AEC business is impacted by a structure's shape, including cost, land use, material consumption, heat loss, noise exposure, light exposure, and energy use, to mention a few.

There were five steps in the methodology employed for this paper: (i) Conducting a thorough review of the pertinent literature that is currently available; (ii) researching the issues that industry representatives are currently bringing up in various industry forums; (iii) conducting one to one interview; (iv) analyzing the information gleaned from the interviews; and (v) connecting the literature and the interviews to draw a conclusion.

Phase I The purpose of the literature study was to gain knowledge about artificial intelligence, its applications in the AEC sector, and the nature of creativity in general and how it relates to design thinking. To assess the current state of the AEC market, stage (ii) involved mostly using Google to locate articles, blog posts, company reports, webinars, and other comparable media created by businesses that address issues related to AI deployment and application in the AEC sector.

Semi-structured interviews were conducted in stage (III) with industry representatives who either currently work in the AEC industry, have experience working in the AEC industry or educational systems related to it in the past, or work with education closely related to the AEC industry, such as university education or civil engineering or architectural engineering. Table B1 in Appendix B contains a list of interviews. The interviewees were selected based on their prior research on the paper's pertinent subjects and/or their involvement in AI-related projects and implementations in the AEC sector.

Each interview was conducted in a semistructured manner using a planned set of questions (see Table A1 in the appendix). The questions were mainly open-ended, allowing the interviewee to explore additional issues that they thought were significant to the interviewer. An open-ended question allows the interviewee to speak freely and passionately about certain topics in which they have extensive experience. Each interview covered the same issues: artificial intelligence, generative design, creativity, design creativity, architecture, digital design, and other topics that were closely connected; however, the interviews also focused on the specific field in which the interviewee had the most experience. The data was organized according to what each answer, or piece of an answer, meant in terms of the creativity framework and the four Ps. The data acquired from the interviews and previously studied material were presented as the study's findings and provided the basis for the paper's conclusion in the final step (V).

V. DISCUSSION AND ANALYSIS

After reading numerous papers and conducting extensive study on the suggested issue, half of them concurred that artificial intelligence facilitates the design process by storing, exchanging, gathering, merging, and analyzing data. All robots were originally designed with this in mind: to make human labour easier and reduce the time needed for each task. Though AI is short for artificial intelligence, which is distinct from robots, their arguments are not relevant to AI because AI computers are meant to be intelligent machines that are meant to learn, perceive, and suggest intelligent solutions that humans can perform. (Christopher Collins a, 2021)

AI cannot understand architecture; architecture is described as the constructed environment that offers humans stability, beauty, and comfort on a psychological as well as physical level. In the same way that AI introduced the parametric design platform, which is currently popular, it will likely suggest other new structures and forms. It can be argued that architecture is trying to understand what vernacular architecture and cities were like prior to their intense industrialization. People's needs are evolving. People will eventually start to have different ideas about what architecture should be and gorgeous, intricate constructions that don't really add much to comfort. AI will not be able to keep up with this. If only artificial intelligence could advance to the point where additional platforms are created that offer architects every tool, they need to meet these expectations in the future. (Haenlein, 2019)

Since there is not a complete solution yet, the research does not fully address the research questions that were posed. When we discuss artificial intelligence, we are discussing a topic that is still in its infancy and will become a part of the world in the future. Whether this is a good thing or a bad thing, it is still in its infancy and has already permeated every aspect of life, from household chores to urban planning to life on Mars. Nonetheless, it is predicted that AI will revolutionize architecture in the future as practice, design, and building, and the chance of AI taking over the architect's work in conclusion is less likely. According to all the points given above, AI will never be able to outperform a genuine architect. Furthermore, the research would have been stronger if additional books and journals had been offered for this debate, and because there was a lack of evidence, more supported references and statics are required.

Our findings imply that AI does not challenge the core ideas of design thinking. Instead, it strengthens them even more. We examine how AI eliminates constraints in conventional human-intensive design to bolster this claim. More precisely, we begin with the results of a comprehensive analysis that one of us carried out on AIpowered tactics. The study demonstrates how the removal of three constraints—scale, scope, and learning—affects an organization's operational model. The size restrictions of traditional design approaches were severe. Being one of the most labor-intensive human-based endeavours, it demanded a substantial time and resource commitment. particularly throughout development when numerous minute decisions had to be made. Because of this, it was impractical to provide a solution for each and every user need. AI makes it possible to eliminate large scale design constraints because machines are now able to build customized solutions. Firstly, these devices incorporate design principles that are fundamentally user-focused. It is interesting to see that scale and people-centeredness no longer correlate with each other. It was more difficult to focus on individuals in human-intensive design the more users and complicated the insights were.

VI. CONCLUSION

Artificial intelligence distinguishes itself from other types of digital technology. It facilitates learning, which is essential for innovation. As a result, it offers never-before-seen opportunities to significantly reduce the cost and length of developing a new solution. The design process was discovered to be essentially dependent on creativity, with various aspects influencing creativity. Since artificial intelligence is a relatively new field and is continuously being developed, its impacts on the architecture profession are currently unknown. The benefits of artificial intelligence (AI) are drawing people and businesses to use it, but it is yet unclear how this will affect jobs, industries, and people's daily lives. AI in architecture will lead to more efficient building design and construction, as well as the creation of innovative solutions that will push the frontiers of architectural advancements. It also presents a chance to explore new avenues for applying AI to improve the world.

6.1 Sustainability

The development of new technologies and innovations is essential to the transition to a more sustainable future. Innovation is nothing new to the construction sector, which has long aimed to create better, more energy-efficient structures with less waste and less material. According to this study, AI can help reduce the amount of material used to address these difficulties. By providing designers with additional data, they may create compact solutions using less material and optimize building square meter consumption, resulting in a reduction of wasted space. In terms of environmental sustainability, AI will play a significant role in the industry, which is now grappling with material waste and optimization. (Gibson, 1977) AI presents itself not only as a tool for increasing environmental sustainability, but also as a tool for increasing social sustainability. Already established data sources, such as Google Home and Amazon Alexa, provided in the study, could serve as beginning points for AI to construct socially sustainable systems. (Boland, 2004) In terms of financial sustainability, AI can assist by possibly forecasting financial events that affect the prices of construction materials or services, purchasing material at lower prices. and purchasing material at the optimal period of construction to minimize stockpiling or delays. The relationship between economic and social sustainability is often intimate. For example, if artificial intelligence (AI) is used to assist in the creation of beautiful and socially responsible homes, this will impact the local economy. Higher living standards and increased job opportunities in certain places are two ways that attractive housing can boost the local economy. Given that this study identifies a wide range of potential applications for AI, it is critical to remember that the user determines how the technology is employed.

6.2 Limitations

Of course, there have been challenges and restrictions that have impacted the paper's results. One drawback is that many of the interviewees had little to no experience working with AI, and their awareness of AI was confined to its novelty in the construction and common language industries. While some participants had more expertise with AI than others, all of them had a strong background in the construction industry, which was a plus when considering the possible applications of cutting-edge technology like AI. An additional constraint is to the quantity of interviews conducted, which may be accounted for by the restricted duration and novelty of the research field, which posed challenges in identifying motivated interview subjects with pertinent experiences.

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Appendix A

Table A1: Interview Template

Demographics		
D1	Who are you?	
D2	What have you done for the past years in the construction industry/education?	
D3	Have AI had any part in those projects?	
D4	What are your experiences with AI in those projects?	

Experience with AI		
A1	Where is the AI implemented?	
A2	Has it been successful?	
A3	Where does the industry want more AI?	
A4	Where do you expect to see AI implemented in the industry or in your line of work?	

Creativity			
C1	What is your perception of creativity?		
C2	Do you consider yourself creative? How does it show?		

AI related to Creativity			
1	How do you think AI affect creativity? In the design process? In other industry related processes?		
2	Do you believe that AI can enhance creativity or limit it?		

Conclusive Questions				
1.1	Based on what we talked about in the interview, do you believe there was something we missed that you would have			
	liked to talk about?			
1.2	Do you have any contacts, colleagues or friends that might be interested in participating in an interview?			

Appendix B

Table B1:	Interview Participants

Respondent	Role	Sector	Years of Experience
R1	Associate Professor	Architecture	20+
R2	IT Professor	Construction	15+
R3	Senior Architect	Architecture	25+
R4	Junior Architect	Architecture	07+
R5	Senior Architect	Architecture	30+
R6	Associate Professor	Construction	20+
R7	Senior Architect	Architecture	18+
R8	Architect	Architecture	12+