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Artificial Intelligence in Architectural Design

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ABSTRACTS

Artificial intelligence is one of the methods in elaborating design, especially on architectural design. This method has been adapted to many designs, such as building complex, massing models. This study aims to determine the influence of artificial intelligence in forming complex conceptual designs in architecture. We used a case study method by examining documents or journals related to research to conduct this research. The results show that more than 50% of artificial intelligence helps architects make conceptual designs. This is due to artificial intelligence's ability to analyze data and turn it into a draft plan. Then, it will be analyzed by the architect will so that they can make the final plan. However, there is still a bad influence that allows an architect to be replaced by automation. Therefore, that means artificial intelligence must be used with great responsibility.

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1. INTRODUCTION

Many people associate artificial intelligence with robots. Even so, robotics is a branch of technology that is directly related to robots. A robot is a machine that is programmed to do various things automatically or semi-automatically (Mohammad, Z., 2019). Therefore, it is different from the field where artificial intelligence is located. Artificial intelligence is like a moving target. Artificial intelligence is a system's ability to interpret external data correctly. To study this data, we used the learning outcomes to achieve a specific goal through flexible adaptation.

Meanwhile, Poole and Mackworth (2010) explained that artificial intelligence is a field that studies the synthesis and analytics of computational agents that apply intelligently (Bartneck, C., et al, 2021). Moreover, artificial intelligence can generally be referred to as machine learning and is a very fast-growing technology. Research on artificial intelligence typically focuses on image, writing, and voice-based applications, which provide breakthroughs for driverless car development, speech recognition algorithms, and recommendation systems (As, I. and Basu, P., 2018). Artificial intelligence (AI) is a computer science branch, which involves developing computer programs to complete tasks that require human intelligence. AI algorithms include learning, perception, problem-solving, language-understanding, and logical reasoning (Mohammad, Z., 2019). AI can be used in many ways every day, from personal assistants to organizing our schedules, cell phones that provide recommendations for songs that we like, and driverless cars (Leyva-Vazquez, M.,

et al, 2018). Apart from facilitating our lives, AI can also help us solve some of the world's problems, namely treating chronic diseases, fighting climate changes, and anticipating meteors' threats. AI was the most strategic technology in this 12th century. Therefore, with its arrival, several things will be replaced (Leyva-Vazquez, M., et al, 2018).

A previous study has described that BIM (Building Information Modeling) is software capable of artificial intelligence. It can assist architects in modeling and testing designs without going directly to the project site (Shourangiz, E., et al, 2011). Also, there is a study regarding Deep Neural Network (DNN), an application that uses a graphic approach to produce conceptual designs (As, I., and Basu, P., 2018). Artificial intelligence can be used to analyze cities, plan, and designing cities (Batty, M., 2018). However, this artificial intelligence must be used responsibly to bring out positive changes in cities, communities, and businesses. Artificial intelligence can provide solutions to urbanization problems that are difficult to solve due to its complexity (Yigitcanlar, T., et al, 2020)

This study aims to determine the influence artificial intelligence impacts the field of architecture, especially in designing complex buildings or areas. We used the case study method by examining documents or journals related to the study we conducted to do this study

2. METHOD

To achieve this paper's objectives, we first collected various journals related to the research topic. In collecting these

journals, we do it online. After the journals are collected, we analyzed the journals to find out the results of their discussions. We do this analysis qualitatively based on theory. After the results of the analysis were obtained, we continued to compare the journals with each other. This comparison is intended to determine the average results of the research conducted. From the average results of these studies, it can be concluded that artificial intelligence has a positive or negative effect on architectural design.

3. RESULTS AND DISCUSSION

The results showed that artificial intelligence could influence the development of architecture itself. Long before artificial intelligence was developed, architects still used paper, pencils, erasers, and drawing tables to draw or design a building. However, with the rapid development of artificial intelligence, many software is made to facilitate this task. For example, it is sketched up and AutoCAD. Therefore, architects no longer need to take a long time to design and reduce paper usage.

Artificial intelligence is intelligence that is carried out by machines and software. However, this cannot be done. The computer or machines must be adaptable, independent, and intuitive. Several elements are needed by machines to be called artificial intelligence (see Figure 1). To do this, Alan Turing, a mathematician, applied the Turing Test. The Turing test aims at determining whether the computer has successfully disguised itself as a human. The test is performed under a complex set of conditions under human supervision, with the test subject being a computer.

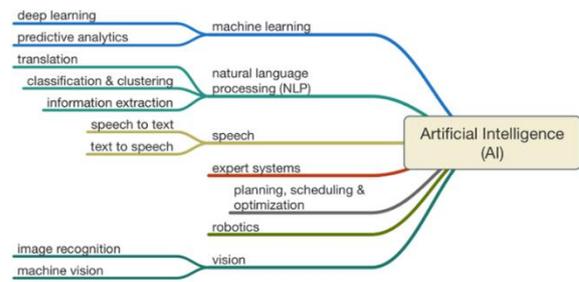


Fig. 1. What a Machine Needs To Be Intelligent

Source:

<https://futurearchitectureplatform.org/news/28/ai-architecture-intelligence/>

Simply put, these machines were performed to obtain information about their environment and then disseminate it to build new knowledge about their environment. Furthermore, from the renewal, a generalization was made to deal with the environment's problems (Jain, L, C., et al, 2016).

Since then, artificial intelligence has always developed rapidly. Moore's Law explains that over the passage of computer hardware, the number of transistors in integrated circuits has doubled every two years. It can be a trigger if, in the future, computers can design better than humans. Moreover, artificial intelligence is still in the ANI (Artificial Narrow Intelligence) stage, or it can also be called Weak AI (see figure 2). It means that it can only handle chess games and complex algorithms but cannot make intuitive decisions like humans do.

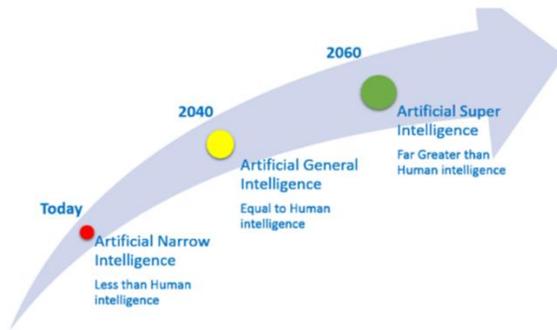


Fig. 2. Future Development of Artificial Intelligence

Source: Mohammed, Z. (2019). Artificial Intelligence Definition, Ethics, and Standards. The British University in Egypt.

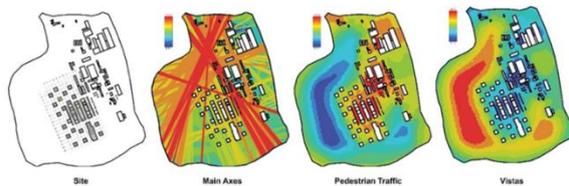


Fig.3. Site analysis using depthmapX

Source:

<https://futurearchitectureplatform.org/news/28/ai-architecture-intelligence/>

Artificial intelligence exists and is often used by architects to work on their projects, such as calculators and BIM. Another example is the use of 'depthmapX' software to analyze spatial networks at various levels without the need to be directed at the site location, shown in Figure 3. Besides, the use of game software, which game developers commonly use, can be used by architectural interests. Unity 3D is one of them. By invoking the project built into it and using the artificial intelligence at its disposal, the architect can find the shortest distance to the fire exit.

Now many programs can design the best room layout according to the entered data. Artificial intelligence can directly design complex buildings, and architects only need to add the finishing touches. It can be determined which direction the building should be facing (see figure 4). Besides, artificial intelligence can also simulate the environment. EcoDesigner is a software that can do this. Architects can perform building and environmental analyses without having to go directly to the project site.

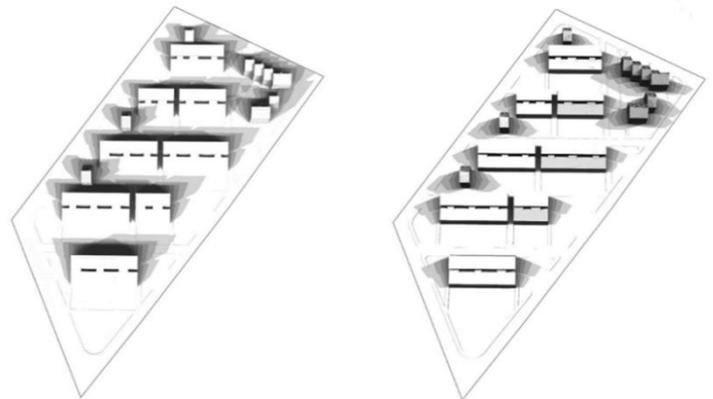


Fig. 4. Observation of sunlight using various kinds of software

Source:

<https://futurearchitectureplatform.org/news/28/ai-architecture-intelligence/>

Access to the community's information that combined with artificial intelligence can also make it easier for architects. By knowing your hobbies, likes, dislikes, activities, friends, income, and more, artificial intelligence can predict the virtual future and automatically compile the best urban planning. Simply put, the data that is uploaded by the public will be sorted by artificial intelligence and analyzed until they get a draft plan. Then, this plan is

fixed by the architect, which later becomes a better plan and is finished.

Diagrams 1 and 2 (see figure 5) explain data collected from the community, which is then analyzed by artificial intelligence to form a draft plan. The architect will analyze the draft plan again to form a final plan.

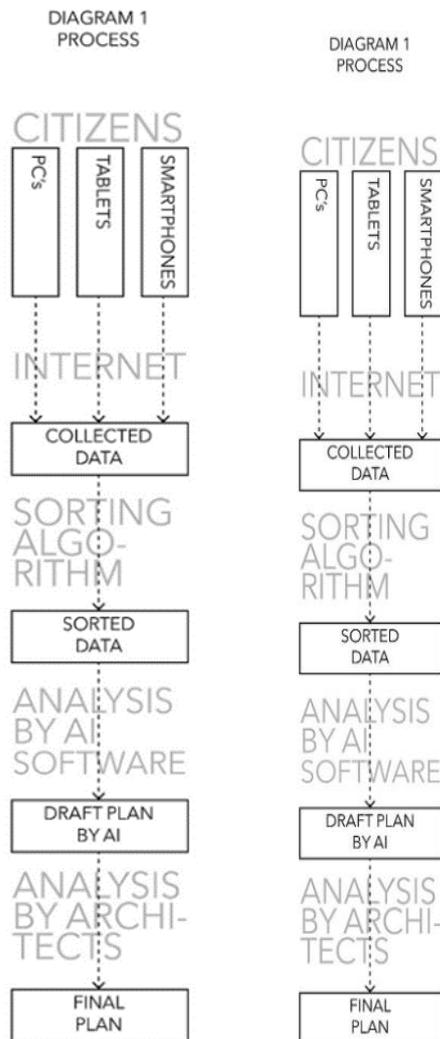


Fig. 3. Diagram of the Data Collection Process by Artificial Intelligence

Source:

<https://futurearchitectureplatform.org/news/28/ai-architecture-intelligence/>

Tesla Motor's Autopilot was also conducting a similar example. Every

Tesla car always uploads the latest data about the road they are on. This information is collected and used as a reference for the future. It makes the Tesla car always up to date with road conditions. The same can be used for architectural purposes. This artificial intelligence can provide architects data to determine the number of vehicles passing on the road and prioritize repairs, road widening, and lane changes.

The use of artificial intelligence in architecture and urban planning can change things for the better. Architecture can be developed into a new work scope that uses automation with all its advantages and disadvantages (Gunagama, M, D., et al, 2017). Artificial intelligence can be used in many aspects and fields. It is only a matter of time until artificial intelligence becomes better than the human performance itself (Hadiana, A, I., 2020).

4. CONCLUSION

The influence that artificial intelligence has on architecture is immense. Artificial intelligence manifests into several software that architects can use. This makes the work of the architect easier. Therefore, the work can become shorter and more concise. The use of artificial intelligence in urban planning is also very helpful for architects. With the abilities they have, it is easier for architects to know what the city needs to improve the quality of people's lives. However, there is also the negative effect of artificial intelligence itself. On in its increasingly rapid development, architect services might be no longer used. This applies to not only architects but to all services which can be taken over by artificial intelligence. Therefore, we

must be able to use it responsibly and not rely on it.

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