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Artificial Intelligence Prospects in Civil Engineering

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Abstract: *The digital shift has arrived in the construction industry, with the aim of increasing the efficiency. However, how should the industry implement digital tools? And how should a human-technology relationship work? The purpose of this paper is to illuminate how the construction industry can close the gap between the potential benefits and the harvested benefits of implementation of AI.*

Keywords: AI, civil engineering, algorithms, ML, DL, branches of AI

I. INTRODUCTION

Artificial Intelligence (AI) is a specialised system that can recognise intelligent entities, make decision-making easier, faster, and more efficient. Artificial intelligence is concerned with the roboticization of intelligent behaviour that thinks and acts the same way people do. It is a broad concept that has become firmly ingrained in our daily lives. It is built on the collaboration of numerous fields, including computer science, cybernetics, information theory, psychology, and neurophysiology, among others.As a result, artificial intelligence is a discipline of science concerned with the study, design, and implementation of time-saving technologies. AI is concerned with machines that carry out tasks.

In the field of civil engineering, many problems, especially in engineering design, construction management, and program decision-making, were influenced by many uncertainties which could be solved not only in need of mathematics, physics, and mechanics calculations but also depend on the experience of practitioners. This knowledge and experience are illogically incomplete and imprecise, and they cannot be handled by traditional procedures. However, artificial intelligence has its own superiority. It can solve complex problems to the levels of experts by means of imitate experts. All in all, artificial intelligence has a broad application prospects in the practice of civil engineering. [2]Application of AI in the field of civil engineering is in construction management, building materials, hydraulic optimization, geotechnical and transportation engineering, & also useful in developing robots & automated systems.

1.1 Objectives

- To Study the prospects of AI in civil engineering
- To study current implementation of AI in Civil Engineering.
- To get insights how AI can be a game changer for AEC industry.

II. STRUCTURAL HEALTH MONITORING

Structural health monitoring (SHM) is the process of using sensors to continuously monitor the health of structures such as buildings, bridges, and other infrastructure. By analysing the data from these sensors, SHM systems can detect damage, predict potential failures, and enable proactive maintenance.

Here are some ways in which AI can be used in SHM:

- **Anomaly detection**: AI algorithms can be trained to detect anomalies in the sensor data that might indicate damage or degradation. These algorithms can learn to identify patterns that are not easily detectable by humans.
- **Predictive maintenance**: AI can be used to predict when maintenance is needed based on the sensor data. By analysing the data over time, AI algorithms can learn to identify patterns that indicate when a structure is likely to require maintenance.

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- **Image processing**: AI algorithms can be trained to analyse images of a structure to detect damage or deformations that might not be easily visible to the human eye. This can be done using techniques such as computer vision and machine learning.
- **Optimization**: AI can be used to optimize the placement of sensors in a structure to maximize their effectiveness. By analysing data from the existing sensors, AI algorithms can identify areas where additional sensors may be needed.

Overall, the use of AI in SHM can enable faster and more accurate detection of damage, more efficient maintenance, and longer lifetimes for structures.

III. AI & BIM

AI (Artificial Intelligence) and BIM (Building Information Modelling) are two different technologies that can work together to enhance the efficiency and accuracy of building design and construction.

BIM is a process of creating a digital model of a building that can be used for design, construction, and maintenance purposes. It involves using 3D modelling software to create a virtual representation of the building, which includes information on the building's geometry, spatial relationships, and functional properties.

The relation between AI and BIM is that AI can be used to enhance the capabilities of BIM. For example, AI can be used to analyse the data contained within BIM models to identify patterns and make predictions about the performance of the building. This can help architects and engineers optimize the design of the building for energy efficiency, safety, and comfort.AI can also be used to automate certain tasks in the BIM process, such as identifying clashes between building components, generating construction schedules, and calculating material quantities. This can help to streamline the design and construction process, saving time and reducing costs.

In summary, the relationship between AI and BIM is that AI can enhance the capabilities of BIM by providing advanced data analysis and automation capabilities, ultimately leading to more efficient and accurate building design and construction.

3.1 Fuzzy Logic for Traffic Management

Fuzzy logic is a type of math that helps computers make decisions when things are not very clear. In normal math, things are either true or false, but in fuzzy logic, things can be partly true or false. This helps computers make better decisions when they don't have all the information they need or when things are not very clear. Fuzzy logic is used in things like controlling temperature in a room, helping cars drive themselves, and understanding what people mean when they speak in different languages.

Now a day’s predetermined traffic lights are used under time of the day scheme to control traffic congestion. But it does not offer an optimum solution for the fluctuations of the traffic condition. A fuzzy logic control system provides a better optimal solution for the fluctuating traffic system. Controlling the traffic flow system using fuzzy technology has the ability to convert human thinking process into an algorithm using some mathematical models. Implementation of real rules which are similar to the way that traffic policemen would think to manage traffic signal lights can be done by fuzzy if-then rules. The traffic signal controllers are supposed to adjust the cycle time of green light signal depending upon the amount of vehicles arrival which would maximize the traffic flow and control the regular waiting time. The inputs of fuzzy signal control system are generated by the help of an experience. Fuzzy rule based system derives actions from given inputs by constructing if-then rules which represent the relation among the linguistic variables. In general, a fuzzy traffic signal controller will improve the traffic protection in the junction, usage of junction at its maximum level and minimize the delays.

3.2 Concrete 3d Printing

Concrete 3D printing, also known as 3D concrete printing or 3D printed concrete, is a technology that enables the creation of complex concrete structures through the use of 3D printing techniques. The process involves the use of a robotic arm or other similar tool that deposits layers of concrete in a predetermined pattern to create the desired shape. [5]This technology allows designers and engineers to create precise, detailed models of their proposed structures using

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computer-aided design (CAD) software. These models can then be fed into a 3D printer, which uses a variety of materials, such as concrete, plastic, or metal, to create a physical version of the design.[6]

The benefits of concrete 3D printing include faster construction times, reduced labour costs, and increased design flexibility. Additionally, 3D printing can produce structures with more intricate designs and geometries that would be difficult or impossible to achieve with traditional construction methods. [6]

Concrete 3D printing has a wide range of potential applications, including the construction of buildings, bridges, and other infrastructure, as well as the creation of decorative and artistic structures. While the technology is still relatively new and there are challenges to overcome, it is an exciting area of innovation that has the potential to revolutionize the construction industry. [6]

3.3 Construction Scheduling using AI

The construction industry has used manual scheduling techniques for decades, but artificial intelligence (AI) is now revolutionizing construction scheduling. AI-based scheduling offers the potential to drastically reduce construction project delays and costs while improving the efficiency and accuracy of the scheduling process.

AI-driven scheduling systems use algorithms to analyse data, such as historical project data, to create accurate and reliable construction schedules. Using mathematical models and statistical techniques, these systems can identify rules and patterns within the data, which can be used to create highly optimized schedules. This significantly increases the accuracy and reliability of the scheduling process. [7]

Here are some specific ways AI can be helpful:

- **Predictive analytics**: AI can analyse past project data and predict potential scheduling issues before they occur. This can help construction managers make proactive decisions that minimize delays.
- **Resource allocation**: AI can optimize the allocation of resources, such as labour and materials, to ensure that they are used in the most efficient way possible. This can help to minimize waste and save money.
- **Real-time scheduling**: AI can help construction managers create and adjust schedules in real-time, allowing for greater flexibility and responsiveness to unexpected changes.
- **Communication**: AI can facilitate communication between stakeholders, ensuring that everyone is on the same page and that any scheduling conflicts or issues are quickly addressed.
- **Risk management**: AI can help identify and mitigate risks that may impact the construction schedule, such as inclement weather or supplier delays.

3.4 The Future of Artificial Intelligence in Civil Engineering

Artificial intelligence can be considered as the driving force for the future digital transformation of the construction sector. The encouraging results of current AI applications in civil engineering pave the way for even wider use scenarios. [8]

Of course, the challenges to be faced for a wider diffusion of artificial intelligence in civil engineering are still many, and include fairly high implementation costs and the production of systems capable of acting and learning only in the area for which they were designed. However, the AI has shown that it has the potential to transform the construction sector for the better, and there is no doubt that we will soon see its adoption on a large scale.

IV. CONCLUSION

This paper has a motive to just give an insights of AI in civil engineering, and how the construction industry can get progressed by implementing AI. Here I have tried to explain how various branches of AI are helping construction industry to take their projects at peak level, how AI can make life simpler, and cost beneficial.

The use of artificial intelligence will undoubtedly make life easier for humans in the future and may even encourage humans to expand their skill sets. The work for the constructors and architects is getting much simpler due to AI techniques; with each passing day, as the computer is applied more and more popularly, and in civil engineering field will have a broad prospect.

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