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Revolution in Construction Industry with the Help of AI

Akshaykumar M. Karape[1], Shivangi A. Karape[2]
[1]*Head of Civil Engineering Department, Dr. D.Y. Patil Polytechnic, Kasaba Bawada, Kolhapur*
[2]*Lecturer in Civil Engineering Department, Dr. D.Y. Patil Polytechnic, Kasaba Bawada, Kolhapur*

Abstract: ***Civil engineering began with solving problems that were faced by society. Initially, it focused on the implementation of physical and mathematical concepts to solve the problems technically and create engineering solutions. The ancient and modern history of civil engineering, implementing new ideas, techniques, and tools to solve real-time problems through AI. A branch of computer science called Artificial intelligence (AI) deals with the study, creation, and use of intelligent machines. The important areas of artificial intelligence research in civil engineering include structural management and maintenance, as well as design optimization. Data collection, sustainability assessment, and productivity are just a few advantages and prospects that the use of AI in civil engineering offers to civil engineers.***
Keywords: Artificial intelligence, Construction, Ethical aspects, technology, machine learning, transportation,

I. INTRODUCTION

Artificial Intelligence (AI) is a computational framework designed to create intelligent entities and make decision-making simple, quick, and effective. AI creates human intelligence machines and applications and applies to computational technology in a variety of areas, such as informatics, cybernetics, knowledge processing, psychology, neurophysiology, speech recognition, machine reasoning, computer vision, construction, and management and building industry Further, AI is being rapidly influential in our daily, personal, and professional lives. Many difficulties in the civil engineering industry have affected several challenges, particularly in engineering design, construction management, and program decision-making, which could be solved not only when needed. Artificial Intelligence enables the development of structural technologies, automatic data analysis, and analysis of data for monitoring, health protection, idle time management, planning, risk evaluation, decision-making, and project cost control AI plays a useful role in the job site for improving efficiency, quality, and safety in the construction industry. Neural networks may store, memorize, analyse, and process a large volume of data.

II. LITERATURE REVIEW

A. Pengzhen Lu, Shengyong and yujun Zheng

In this study, the intelligent technologies in civil engineering are summarized and introduced together with the latest research findings and applications too. Examination of the use of artificial intelligence technologies in civil engineering is done from every angle possible. The potential applications of artificial intelligence technology in the field of civil engineering were depicted on the basis of the findings of the research carried out.

B. Yougin Huang, Jiayong and Jiyang Fu

A review of how artificial intelligence has evolved and been used in civil engineering over the years is done in the paper. AI algorithms and civil neural networks have been employed in the field of civil engineering and are frequently used for geotechnical, bridge engineering, health monitoring, structural optimization, and structural status evaluation for many years. Big Data technologies and Deep Learning have been successfully used in a variety of civil engineering applications recently. In particular, Big Data has more advanced quickly in the field of structural maintenance and because of the quick development of Deep Learning based computer vision; the ability to monitor the health of the structures using computer vision has significantly improved.

C. Bilal Manzoor

This includes a detailed exploration of the annual publication trend of Artificial Intelligence (AI) in civil engineering towards sustainable development as well as the contributions from top journals in this area, geospatial distribution, and comparisons between developed and developing nations.

The study concluded that automation in construction had a significant impact on artificial intelligence-related publications works and aids in a basic understanding of civil engineering, listing the potential value of artificial intelligence in supporting and enhancing construction work.

D. Yuting Zhang

In this, safety management is adopted as its primary focus and thorough examination of the entire emergency management process which includes the prevention, planning, response, and recovery of civil engineering construction safety incidents. In this, the theory of construction safety incident management is also improved and also encourages the development of emergency response capacity on a practical level

E. L. Sgambi

In this, the study and design of complicated structures like long suspension bridges are discussed and state the use of soft computing is provided as a way to increase the accuracy of the study. For addressing the problems inherent uncertainties and to gain a more thorough understanding of structural behaviour, neural networks, evolutionary algorithms, and fuzzy analysis are used.

III. DIFFERENT TECHNIQUES AND METHODS

A. Genetic Algorithms

It is one of the well-known evolutionary algorithms which imitate the survival of the fittest and the Darwinian theory of evolution in optimization. This has many applications in the field of civil engineering but there are still many areas that need more research and development. By using genetic algorithms, construction planners can create and assess optimal or nearly optimal construction schedule plans that can save project time and expense using a genetic algorithm-based optimization model for linear construction projects.

B. Expert System

It is the first and most successful in the field of artificial intelligence research which is built on the knowledge which is already held by human experts and is established on the established knowledge systems. This technology is used in various areas of civil engineering such as roads, bridges, construction engineering, geotechnical engineering, material engineering, petroleum chemical industries, and other areas extensively.

In the field of structural selection, this system offers a fresh chance for organizing and systematizing knowledge and expertise.

C. Artificial Neural Networks (ANN)

This can be described as a system of closely coupled adaptable simple processing units i.e. artificial neurons or nodes that have the capacity to carry out massively parallel computations for knowledge representation and data processing. This is a kind of simplified technical reconstruction of a biological neural network whose primary goal is to create a workable artificial neural network model in accordance with the theory of biological neural networks and activate some technically implemented intelligent activities of the human brain to address practical issues.

D. Big Data

The quick advancement of big data technology has generated a lot of discussion in the field of science, technology, industry, and even governments worldwide. Engineering, it requires the adaption of data from numerous new sources, including sensors, wireless devices, GPS, and machine-to-machine. The continuous, unstructured, and freedom from the strict structure of rows and columns that characterizes data makes it challenging for traditional approaches to handling. So, the applications of big data are urgently needed.

E. Deep Learning

This is a type of machine learning method that uses numerous layers, starting with the raw input to gradually extract higher-level features. The primary use of deep learning in civil engineering is for monitoring structural health using vision. The traditional shallow neural networks are unable to extract high-level features and even require additional post-processing to explain the extracted high dimensional characteristics, whereas deep learning techniques can employ more training data and more complex network architecture to overcome the challenges.

IV. APPLICATION OF AI IN CIVIL ENGINEERING

A. AI in Geotechnical Engineering

Geotechnical engineering is concerned with the utilization of soils and rocks in engineering structures. In material modelling, soils and rocks naturally display complicated behaviours and a high level of uncertainty. Over the past three decades, more researchers in the field of geotechnical engineering have developed and deployed AI techniques. These techniques have been deemed successful because they can anticipate intricate nonlinear interactions. There are nine major fields where the use of AI methods is prevalent, including frozen soils and soil thermal properties, rock mechanics, subgrade soil and pavements, landslides and soil liquefaction, slope stability, shallow and pile foundations, tunnelling and tunnel boring machines, dams, and unsaturated soils.

B. Artificial Intelligence in GIS

One of the most effective ways of application of AI in geotechnics is AI GIS. Even if GIS is a strong technology with large data sets and many different AI applications, artificial intelligence offers cutting edge techniques for GIS projects. A combination of artificial intelligence technology with various GIS procedures, such as spatial data analysis algorithms (GeoAI), as well as a number of AI and GIS enabled technologies, makes up AI GIS. In recent years, geosciences research and application have increasingly centered on AI GIS. It is effective to address the existing intelligent problem of GIS systems by using AI GIS to improve and sustain the following stage of the evolution of GIS technology systems. Computer vision extraction of geographic information from satellite imaging photos and videos was first realized by AI GIS. Additionally, the development of AI technologies like voice recognition and speech synthesis will provide increased empowerment.

Not only that AI GIS is used in water management and soil moisture. Artificial intelligence (AI)-based water management systems have enhanced crop management and crop health monitoring, prevented water logging issues, contributed to sustained output increases and enhanced farming methods globally. With the world's population expanding and the demand for food items rising, there is a pressing need to strengthen the food supply.

AI can help solve the water crisis by providing tools and techniques. We use low-cost AI-powered sensors to monitor and manage water everywhere. People are fighting for basic survival. We should begin developing these AI-powered intelligent machines to address global issues. AI has all of the answers; we just need to apply it correctly to solve the water scarcity problem. Researchers are using artificial intelligence to create a dependable, sustainable, and resilient water infrastructure.

C. Artificial Intelligence in Soil Mechanics

Researchers claim that the latter method provides a clearer picture of the results for the maximum dry density and unconfined compressive strength of cement-stabilized soil. Liquidity limit, moisture content, cement content, plasticity index, and percentages of sand, gravel, and clay are among the study's inputs. Measurements of the slump of ready-mix concrete can also be made using artificial neural networks and genetic modelling. The study technique makes use of artificial neural networks' capacity for approximation.

V. AI IN CONSTRUCTION INDUSTRY

A. Software Approach

BIM is one of those smart sophisticated technologies which works beyond 3D modelling and building design, Building Information Modelling has significantly impacted the construction process. BIM systems now play a role in every step of the building process, from design to production to project management to handover after a job is finished. Artificial intelligence is already being used by BIM software providers to increase the effectiveness and potential of their programs.

B. Robot as Workmen

The link between technology and the construction industry is complex, and the use of autonomous robots is likely the area where this complexity is most apparent. Construction companies have very limited flexibility when it comes to employee deployment due to their labour forces being overstretched. Any change in their workers' availability can set off a series of events that cause the schedule for the entire project to be altered.

Companies have more flexibility in how their labour resources are allocated when using autonomous robots as a supplement to their workforce, which makes it simpler to adjust to unforeseen absences. Companies deploying autonomous robots can quickly adjust resources to fulfil requests for priorities or tasks to change during a project.

C. Automated Machine

It builds block structures from 3D CAD models quickly and accurately. To increase the effectiveness of residential buildings, special optimization software turns wall designs into block placements and minimizes handling and waste of block products. From the architect to the finishing trades, every supplier involved in the construction of a home will access the same data source, allowing for the simultaneous manufacturing of goods.

VI. BARRIERS THREATS AND RISKS OF AI

A. Barriers

Within the engineering and construction industry, there are many barriers to AI acceptance, and there are parallels with other business segments. This includes incomprehension, a lack of resources a disinclination to alter.

B. Threats

AI isn't coming without any threats. While AI is useful for unstructured data sets, automated sorting, and forecasting and prediction, understanding the why is not ideal, particularly when there are many external factors involved. This includes:

i) Hacking Software ii) Fine-targeted spam emails using social media details scrapped iii) Use adversarial methods and data manipulation to manipulate AI applications vulnerabilities iv)Disrupting autonomous vehicle fleets v)Converting commercial drones to face-targeted missiles

C. Risks

AI poses three different threats:

1) First, smart machines also have implicit prejudices, which are not inherently derived from the designer's purpose but from the data given to training the device.

2) A second possibility is that neural networks deal with mathematical truths rather than abstract truths, unlike conventional structures based on explicit logical laws.

3) A third risk is that when machine learning algorithms make errors, identifying and correcting the precise meaning of the error can be challenging.

Considering all this is not the achievement of excellence but, rather, the best alternative possible.

VII. CONCLUSION

The use and implementation of AI in civil engineering are discussed in this paper. For decades, artificial intelligence algorithms and neural networks have been extensively utilized in structural engineering, computer modeling, systemic situation evaluation, and health control, building engineering, bridge engineering, geotechnical engineering, pathway engineering, and so on. This article deals with the use of smart optimization methods in structural engineering and field research. Artificial intelligence can change day by day and can grow when computer programs are implemented in vast numbers. Phase by step, falsified understanding progresses, as the fundamental structure and its degree of systemic complexity grow to an ever greater extent.

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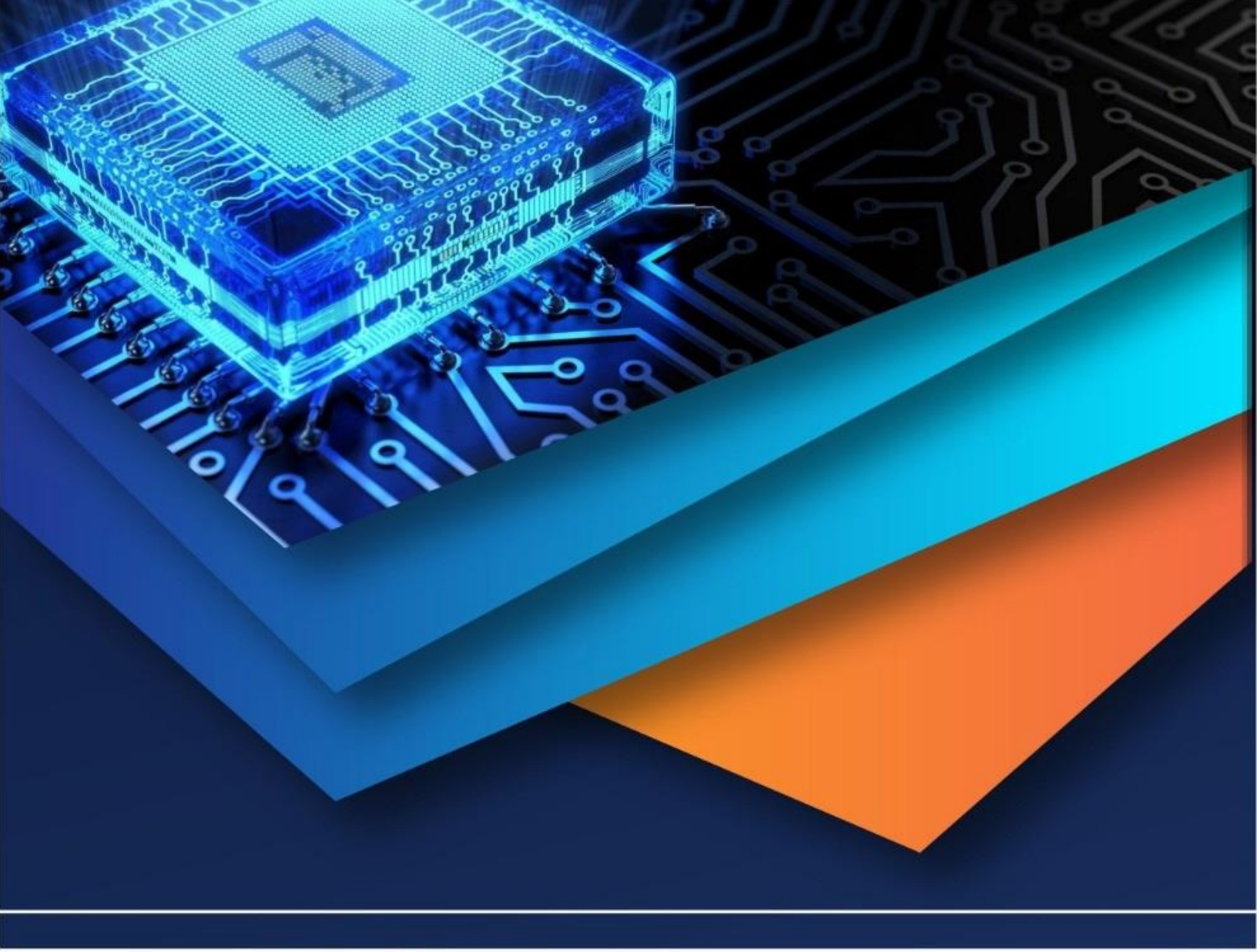

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