International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 01 | Jan - 2025 SJIF Rating: 8.448 ISSN: 2582-3930

Using Artificial Intelligence to improve safety planning & monitoring of construction projects

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Abstract - The construction industry is inherently fraught with safety risks, making it imperative to adopt innovative solutions for effective safety planning and monitoring. Artificial Intelligence (AI) is emerging as a transformative technology in enhancing safety protocols in construction projects. This abstract explores the application of AI in mitigating safety hazards and ensuring a secure work environment.

AI-driven solutions, such as computer vision, enable real-time hazard detection by analyzing visual data from construction sites. Predictive analytics leverages historical safety data to foresee potential risks, facilitating proactive measures. Wearable technologies, powered by AI, monitor workers' movements and health metrics, offering timely alerts to prevent accidents. Additionally, autonomous equipment reduces manual intervention, minimizing the risk of human error.

Proximity warning systems using AI and RFID technology further enhance worker safety by alerting them of imminent dangers. The integration of these AI technologies not only mitigates risks but also fosters a culture of safety and compliance in construction projects.

As the construction industry continues to evolve, the adoption of AI-driven safety measures stands as a pivotal step toward achieving a zero-accident work environment. The insights gained from AI applications pave the way for a safer and more efficient construction landscape.

***Key Words*:(** Artificial Intelligence (AI),Construction safety, Predictive Analytics, Safety Management, Data Analytics, Hazard Detection, Worker safety.)

1.Introduction

The construction industry, known for its complexity and inherent risks, faces significant challenges in ensuring worker safety. Traditional safety protocols, while essential, often fall short in mitigating dynamic hazards and responding to real-time threats. This calls for innovative approaches to enhance safety measures and create a secure working environment. Artificial Intelligence (AI) emerges as a powerful solution, bringing forth advanced capabilities in safety planning and monitoring.

AI technologies, with their ability to process vast amounts of data and identify patterns, offer unprecedented opportunities to transform construction safety. By leveraging computer vision, predictive analytics, wearable devices, and autonomous equipment, AI not only predicts and prevents accidents but also provides real-time alerts and interventions. These AI-driven solutions enable proactive safety management, ensuring that potential risks are identified and addressed before they escalate into serious incidents.

The integration of AI in construction projects signifies a paradigm shift towards a more intelligent and responsive safety framework. It empowers stakeholders with actionable insights, fosters a culture of safety, and ultimately aims to achieve a zero-accident work environment. As the construction industry continues to evolve, the adoption of AI technologies stands as a crucial step in redefining safety standards and practices.

2. Methodology

- **Predictive Maintenance:** AI-enabled sensors can foresee equipment breakdowns and plan maintenance tasks, minimizing downtime and extending the life of the equipment.
- **Safety Monitoring:** AI-powered cameras can scan building sites for potential safety dangers and immediately alert project stakeholders, allowing them to take appropriate action.
- **Material Management:** AI-powered analytics can monitor how building supplies are used on the job site, streamlining the supply chain and cutting down on waste.

- **Structural Health Monitoring:** AI-based structural health monitoring uses sensors, machine learning, and data analytics to quickly identify any structural deterioration or irregularities. This technology can benefit a variety of industries, including infrastructure, construction, and transportation, by preventing structural failures, enhancing safety, and lowering maintenance costs.

Process

AI- Based Construction Progress Monitoring

Al-based progress monitoring for construction projects is a cutting-edge method for following and managing projects in a more effective andefficient manner. Al can offer real-time insights into the status of a building. project with the assistance of cutting-edge technologies like machine learning, computer vision, and data analytics.

Workflow for Al-based Construction Progress Monitoring

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Data Capture : Effective progress monitoring in construction has been significantly hampered by poor data availability and quality. But by combining several data sources, such as sensor data, drone footage, lidar scanner, and 360 cameras, Al can produce a thorough and precise dataset for progress tracking. To find patterns and trends in the development of the building project, this data can subsequently be examined using machine learning techniques.

Data Processing: Even in difficult, non-linear building projects, Al systems can aid in identifying and quantifying progress. Al is able to forecast task durations by training machine learning models on historical data and comparing predicted task durations to actual task progress. Stakeholders in the project may be able to recognize potential delays or concerns early on and take appropriate action as a result.

Data Visualization: Data visualization is a critical part of construction progress monitoring using Al. By visualizing data, project managers can track progress, identify trends, and make informed decisions to optimize resources and ensure project completion on time and within budget. Visualization techniques include time-lapse videos to provide a visual representation of the construction project over time, 3D models created using BIM data, and graphs and charts to visualize data such as labor hours, equipment usage, and construction milestones.

5. Project Implementation Plan

Phase 1: Planning and Data Collection

- Identify key safety challenges and requirements.
- Collect and analyze historical safety data.
- Conduct site assessments to determine the placement of cameras, sensors, and other monitoring equipment.

Phase 2: AI Technology Deployment

- Install and configure AI-powered cameras, drones, and wearable devices.
- Integrate AI systems with existing safety management protocols.
- Train construction site personnel on the use of AI technologies.

Phase 3: Monitoring and Evaluation

- Continuously monitor construction sites using AI technologies.
- Evaluate the effectiveness of AI interventions in reducing safety incidents.
- Collect feedback from workers and site managers to improve AI systems.

6.Expected Outcomes and Benefits

- Reduction in the number of accidents and injuries on construction sites.
- Improved real-time monitoring and proactive safety management.
- Enhanced worker safety and compliance with safety protocols.
- Increased efficiency and productivity on construction projects.

7. Challenges and Mitigation Strategies

- **Data Privacy and Security**: Ensure that data collected from wearable devices and cameras is securely stored and accessed only by authorized personnel.
- **Integration with Existing Systems**: Seamlessly integrate AI technologies with current safety management practices to avoid disruptions.
- **Worker Acceptance**: Address worker concerns and provide training to ensure smooth adoption of AI technologies.

8 .Conclusion-

In conclusion, Al has several advantages for tracking construction progress, including enhanced precision and effectiveness, improved communication and transparency, and a reduction in the time and expense associated with manual tracking and reporting. Construction progress monitoring can be transformed, and project management can be enhanced, by integrating several data sources, using Al algorithms and models, and using standardized data gathering and processing techniques.

9. Future of Al in the Construction Industry

* Based on current research and industry trends, it is evident that Al has significant potential for use in construction progress reporting.

* Al technologies such as machine learning and computer vision can be used to analyze and interpret various types of data, including images and sensor data, to provide real- time information on construction progress.

* Another way Al is being used in construction progress reporting is through the analysis of sensor data. Sensors can be installed on construction equipment, materials, and structures to collect data on various aspects of construction progress, such as temperature, humidity, and vibration.

* Machine learning algorithms can be used to analyze this data and provide insights into construction progress, as well as identify potential issues that need to be addressed.

* Al technologies have the potential to revolutionize construction progress reporting by providing real-time data and insights into construction progress.

10.Referance

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