Artificial Intelligence (AI) Applications in Construction Safety

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Construction Safety

The construction industry is among the most dangerous industries, as one in five worker deaths is related to construction job sites (OSHA 2022). Construction projects are unique, with different rationales and requirements. Safety issues exist within each step of the construction phase at each project.

AI-based Safety Monitoring System

Using artificial intelligence, construction sites can be monitored in real-time and safety risks identified. These sources include surveillance cameras, drones, and IoT devices. Machine learning algorithms detect patterns and anomalies and alert safety managers when safety hazards occur. The proactive monitoring reduces the likelihood of accidents and injuries by allowing timely action to be taken.

Predictive Models for Risk Assessment

Predictive analytics can be used on construction sites to assess and identify safety risks. AI algorithms can identify potential safety hazards based on historical data, weather conditions, and information specific to a project. Using this information, construction teams can plan better safety protocols, allocate resources more effectively, and take preventative measures. In addition to optimizing construction schedules for minimizing risky situations and improving overall safety, predictive analytics can also be used to improve overall safety.

PPE Compliance

Personal Protective Equipment (PPE) compliance can be determined via AI-powered systems analyzing visual data captured by cameras and wearables on the job site. AI-based systems detect and evaluate worker PPE, such as hard hats, safety glasses, gloves, and vests. Using AI algorithms, AI algorithms can evaluate whether individuals follow PPE protocols in real-time by comparing video data with predefined safety guidelines.

Virtual/Augmented/Mixed Reality Training

Construction safety training has been reimagined with AI-driven virtual/augmented/mixed reality (VR/AR/XR) technology. Workers can practice safety procedures, identify hazards, and respond to emergencies using VR/AR/XR simulations. By engaging in these simulations, workers gain hands-on experience without being exposed to potential hazards. With AI, training progress can be tracked, learning can be evaluated, and instruction can be customized to address specific safety weaknesses.

Robotics and Autonomous Equipment

These technologies can reduce hazardous situations caused by negligence or fatigue in part due to their ability to automate repetitive and hazardous activities. AI algorithms can enable these machines to collaborate safely with human workers, thereby preventing accidents. By integrating safety sensors into autonomous equipment, potential dangers can be detected and addressed, further enhancing site safety.

AI Limitations and Challenges

Some of the key limitations and challenges of AI include:

- Availability and quality of data

In order to train and make accurate predictions, AI algorithms require high-quality data. There may be a lack of structure, fragmentation, or incompleteness to data in the construction industry.

- Deficiencies in standardization

There is no standardization of documents, terminology, and procedures. When data sources and systems do not adhere to uniform standards, integration becomes difficult.

- Resistance to change and adoption

The construction industry is resistant to change and new technologies, including AI adoption. Resistance to change and AI adoption can be for various reasons, such as cost consideration, misconception about how AI works, or the fear of losing jobs.

- Managing complex and multidimensional environments

Construction job sites are complex in nature with many factors affecting project activities, such as inclement weather, changes in project specifications, and unique site conditions. AI algorithms may struggle to adapt to these environments and address unforeseeable scenarios effectively.

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