

همزمان با روز جهانی بهداشت حرفه ای ۲۰۲۵

Journal Club

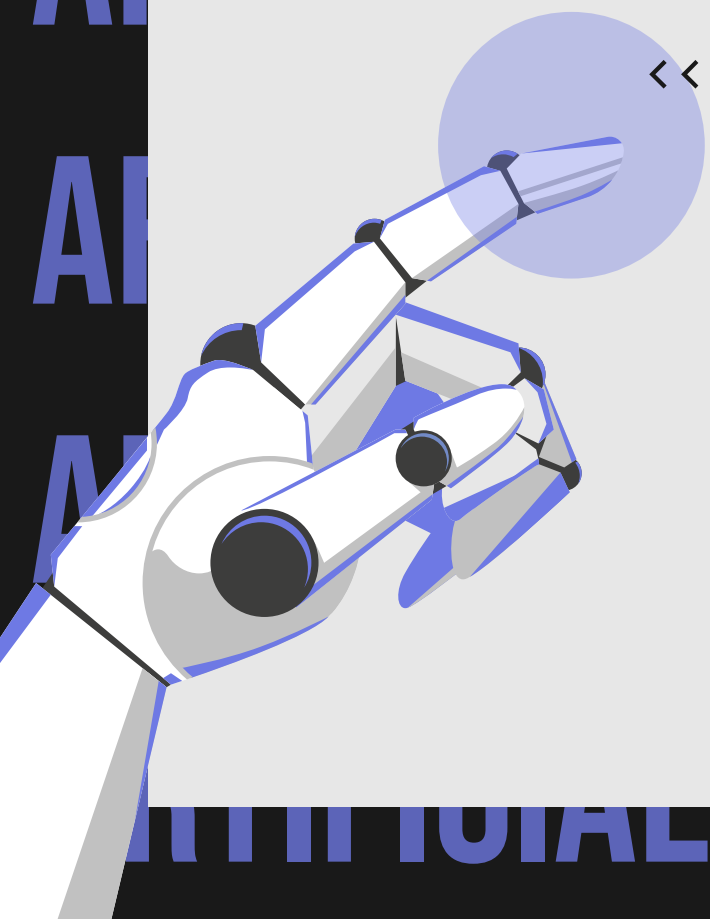
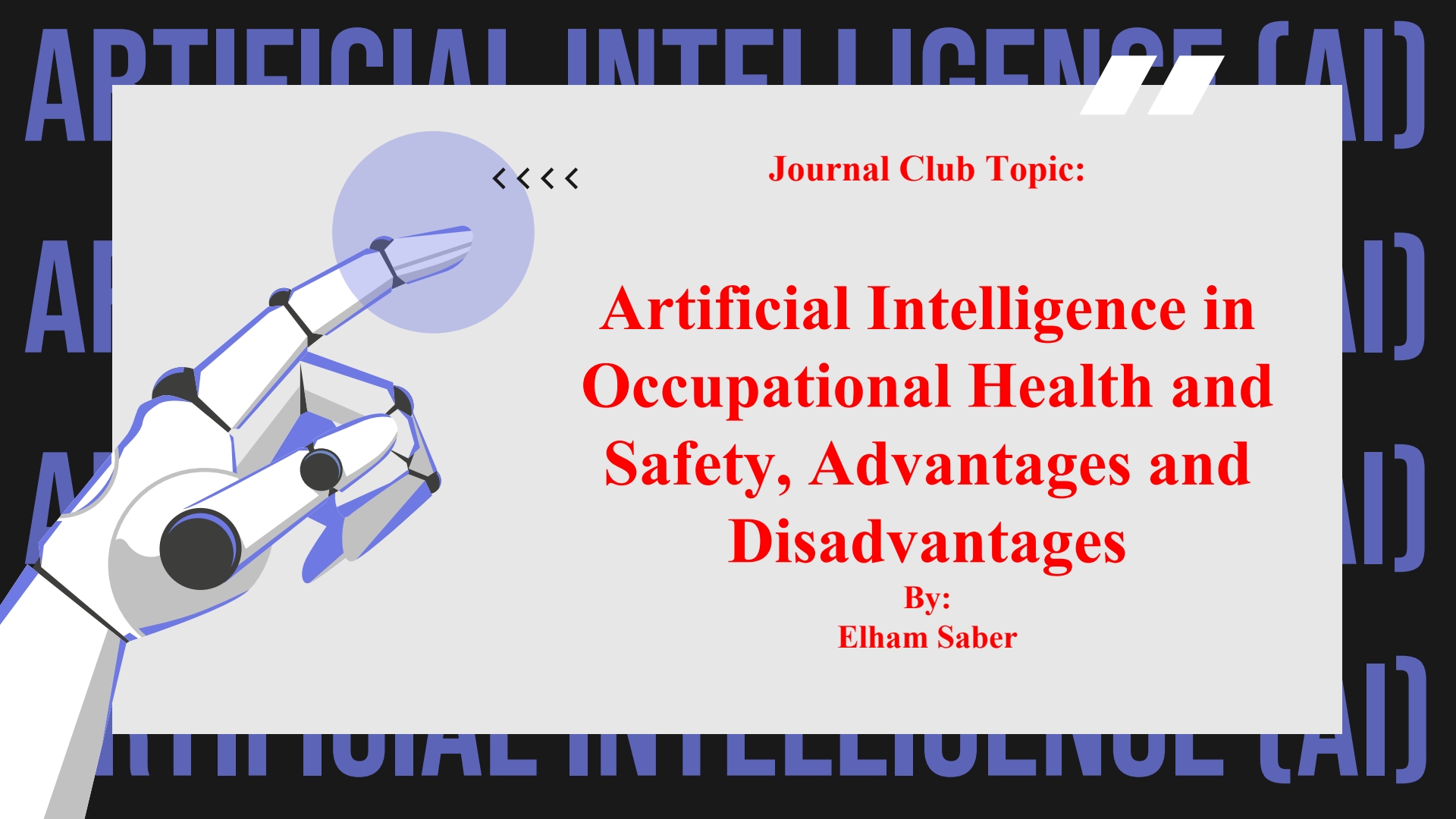
Subject: Artificial Intelligence
in Occupational Health and
Safety, Advantages and
Disadvantages

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مقطع دکتری مهندسی بهداشت و ایمنی کار



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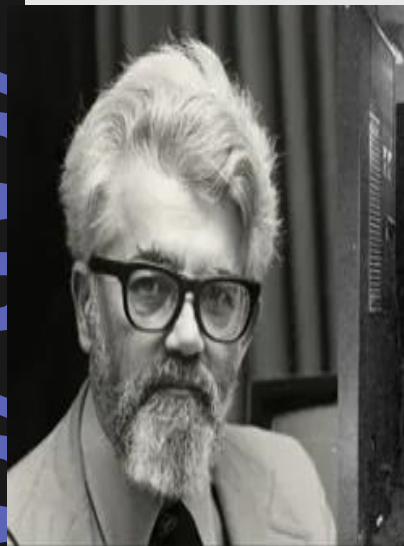
Journal Club Topic:

Artificial Intelligence in Occupational Health and Safety, Advantages and Disadvantages

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INTRODUCTION

In 1955, John McCarthy was the first to create the term ‘Artificial Intelligence’ (AI). AI refers to the simulation of human intelligence in machines that are programmed to **think and learn like humans**. It involves the development of algorithms and computational models that enable machines to perform tasks traditionally requiring human intelligence. These tasks include **problem-solving, speech recognition, decision-making, visual perception, language translation, and more.**



جان مک کارتی



آلن تورینگ



ماروین مینسکی



آلن نیول



هربرت الکساندر سایمون

AI can be divided into two primary categories: - Internet of Things (IoT) optimized for specific tasks and performs well in voice assistants, recommendation algorithms, and image recognition systems and generative AI, i.e., systems that associate words, learn, and solve complicated issues but, despite their name, are not as intelligent as human beings

AI comprises several subfields, such as robotics, computer vision, natural language processing, machine learning, and expert systems. AI mostly relies on machine learning, which uses algorithms to allow computers to learn from experience, providing “intelligent” outcomes without explicit programming.

occupational health and safety (OHS) is defined as a multidisciplinary field concerned with safeguarding and promoting the well-being of individuals in the workplace. The primary goals of OHS are to prevent injuries, illnesses, and fatalities among workers and to create and maintain a work environment fostering the workers' physical, mental, and social health.

Currently, AI enables:

Real-time monitoring of workplace hazards

Identify and assess risks

Increase preventive measures

Improve health protocols

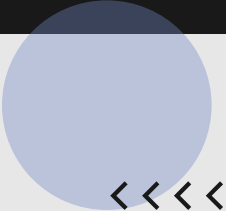
Improve employee well-being

On the other hand, innovative uses of AI in the workplace pose significant **challenges for OHS professionals**, who require a deeper understanding of AI approaches and their potential implications for work and workers. As AI technologies are used in the workplace, it is essential that their potential benefits for OHS are maximized while minimizing any potential drawbacks.

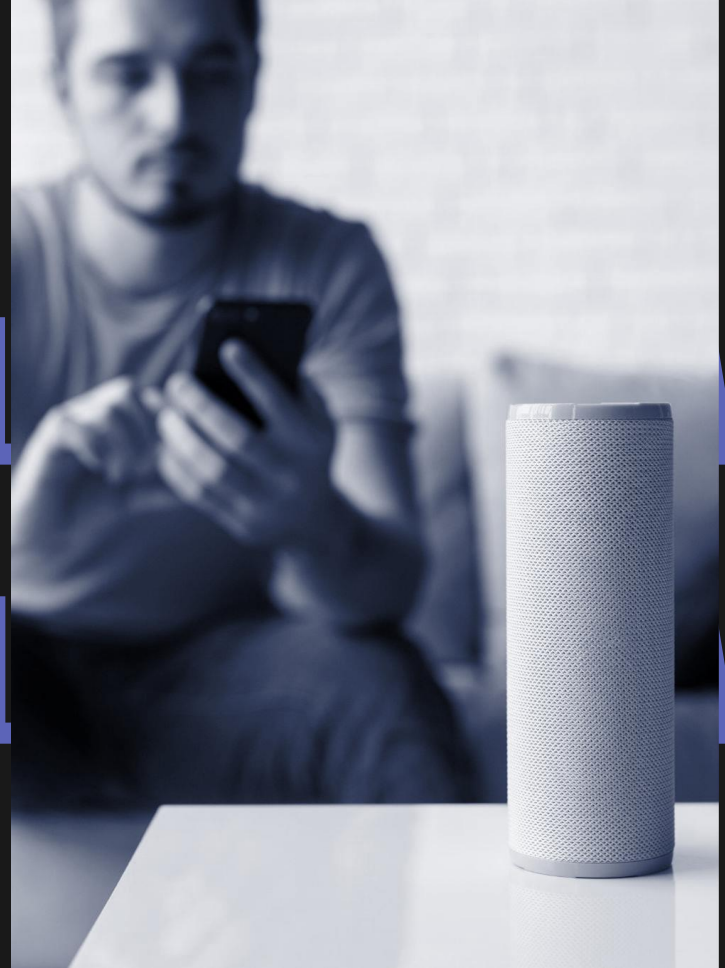
BENEFITS AND APPLICATIONS OF AI IN OCCUPATIONAL HEALTH AND SAFETY

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1. Worker's Health Monitoring Through Wearable Devices, Sensors and IoT Devices



Wearable devices and sensors in the workplace:
pivotal in enhancing workers' well-being, safety, and overall productivity.

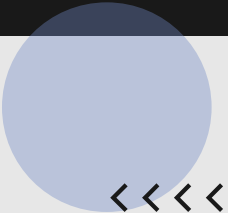
monitor various health metrics, including vital signs, steps taken, and sleep patterns, identify fatigue or stress levels, and promptly notify workers and supervisors in case of emergencies or potential health risks .

In the workplace context, IoT involves embedding **various sensors and other smart devices** into the infrastructure to collect and exchange data. Several studies have shown that companies can use data from wearables, sensors, and AI-powered IoT to identify **potential health risks, such as increased stress levels or irregular sleep patterns**. In addition, data collected by wearables and IoT can help implement targeted wellness programs, including **personalized fitness programs and stress management workshops**, to support the overall well-being of employees.



In hazardous work environments such as construction, mining, and manufacturing, specialized wearable devices such as **sensor-equipped smart helmets** can detect harmful gases, monitor environmental conditions, and assess head injuries. These wearables, integrated with artificial intelligence, trigger automatic alerts or emergency responses in the event of incidents, preventing severe consequences. **This results in increased productivity, reduced absenteeism, and increased job satisfaction.** As these technologies advance, we can envision more sophisticated applications that will change the landscape of workplace health monitoring in the future.

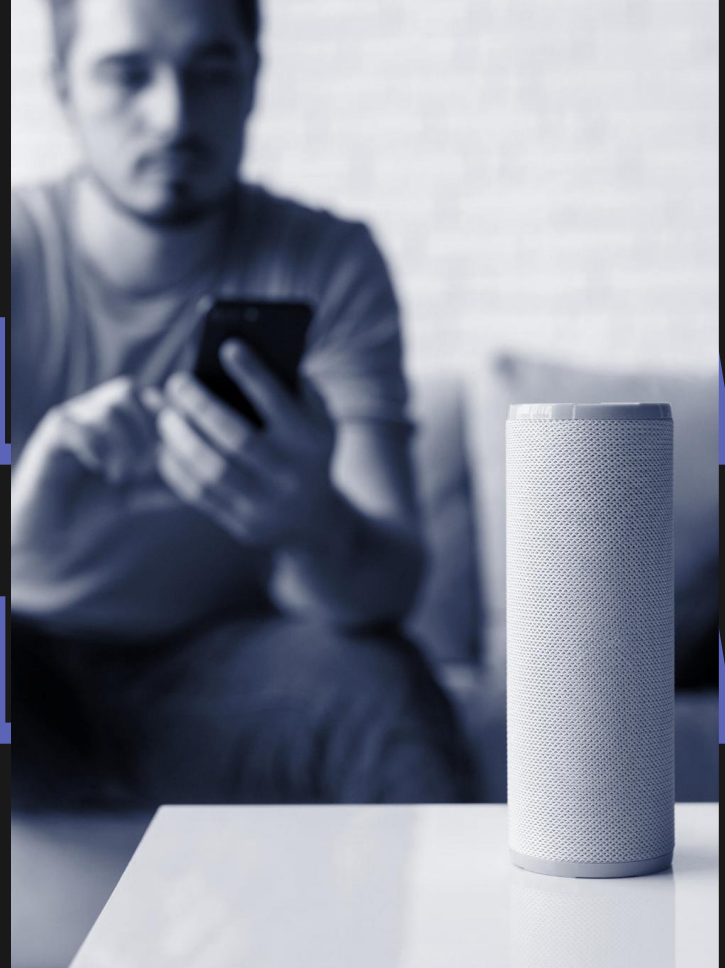
Sensor technology goes beyond wearables and workplace health monitoring, with environmental sensors throughout the workplace detecting factors such as temperature, humidity, noise levels, and air quality. When coupled with AI-based systems, these sensors assess the overall health and safety of the workplace, identify potential hazards, and proactively improve conditions .



2. Smart Building Systems for Energy Efficiency and Employee Comfort

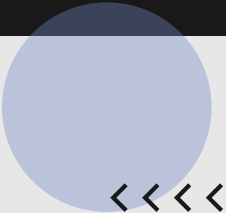


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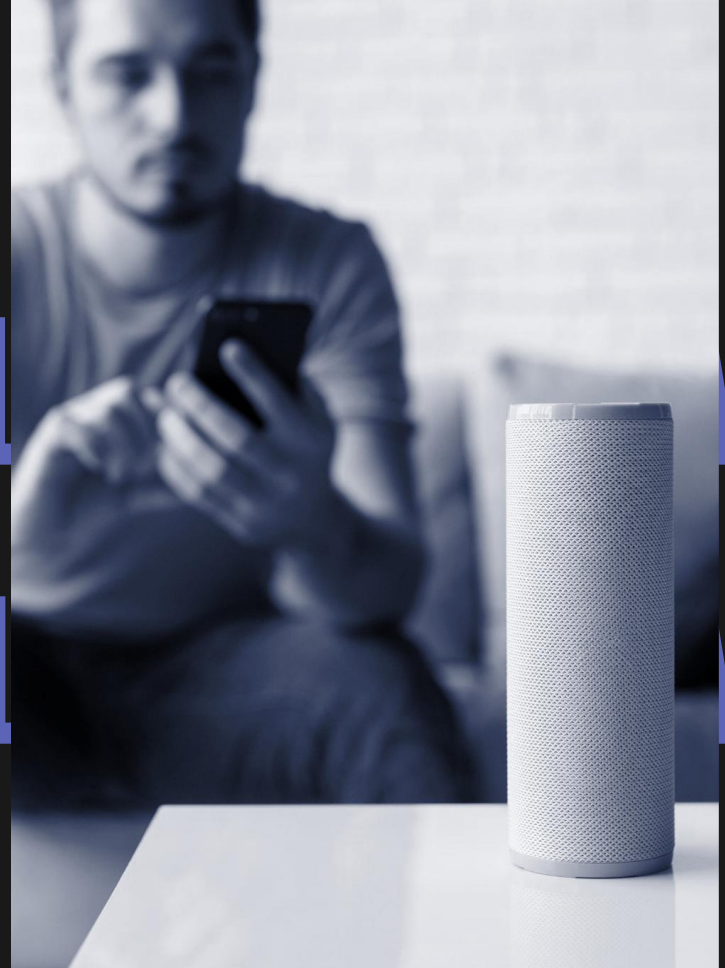
AI can optimize smart building systems to enhance energy efficiency while maintaining optimal conditions for employee comfort . This includes intelligent climate control, lighting, and resource management in the workplace.



3. Hazard Identification and Risk Assessment



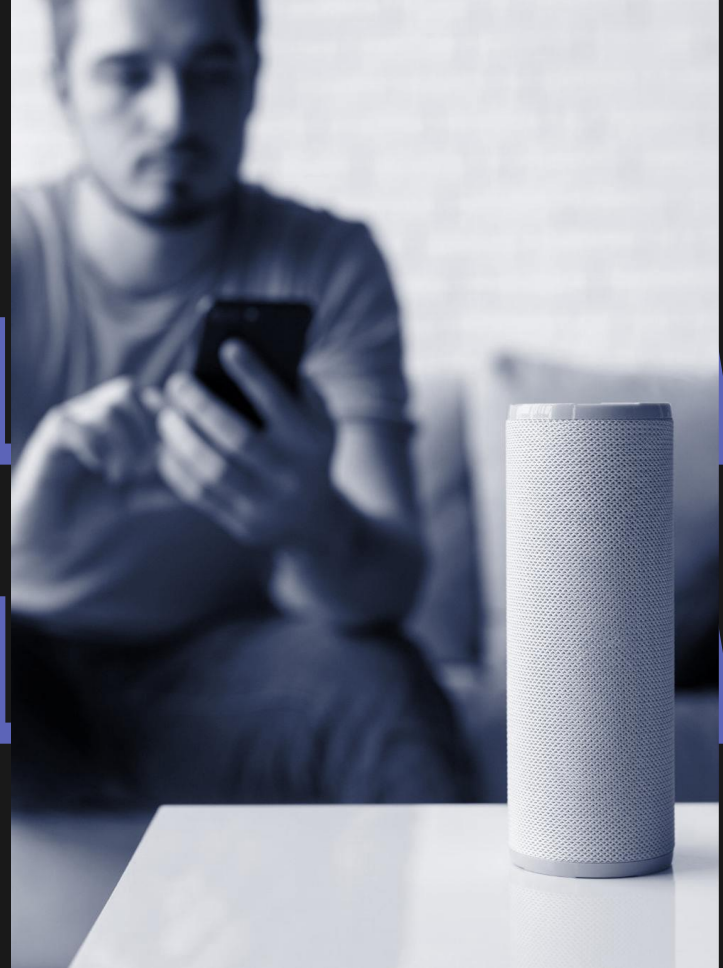
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Hazard detection programs help protect against various hazards, such as unsafe working conditions, workers without protective clothing, improper use of tools and equipment, trip and fall hazards, unattended vehicles, off-site equipment, and other compliance issues. Industries can use AI systems to review images and videos of the workplace and discover potential hazards that may be beyond human observation. Additionally, AI can play a role in predicting machinery failure. Through the analysis of sensor data on machines, AI can identify unusual patterns that indicate a potential fault.

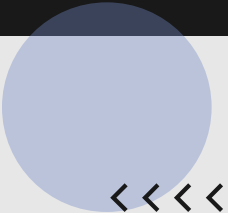
4. AI-Integrated Smart Personal Protective Equipment

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Personal Protective Equipment (PPE), such as respirators, safety shoes, ear muffs, and safety goggles, has always played a crucial role in safeguarding workers from various hazards in the workplace . When a task poses inherent risks that cannot be sufficiently controlled through collective technical or organizational measures, the use of PPE becomes essential to enable workers to perform their tasks with reduced injury risks .

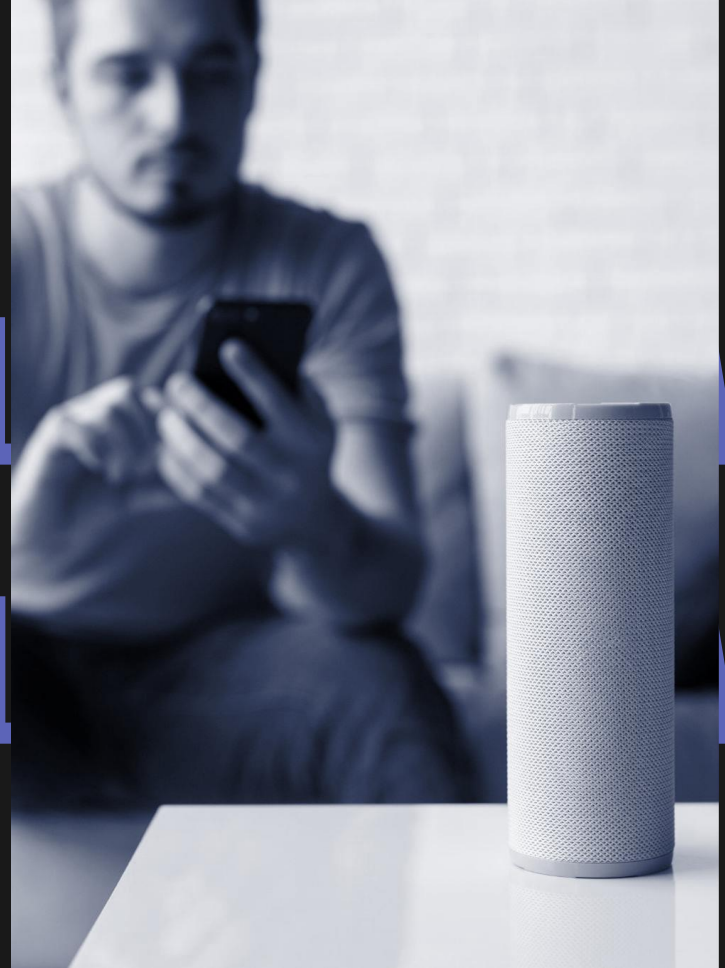
Smart PPE refers to PPE that combines traditional PPE (such as firefighter protective suit) with electronics, such as sensors, detectors, data transfer modules, batteries, cables, and other elements . By combining AI technologies with smart PPE, it actively monitors and adapts to changing environmental conditions, detecting hazards, assessing air quality, and providing real-time alerts. This innovation enhances communication and fosters a proactive approach to occupational safety, ensuring a safer work environment across diverse industries.



5. Workplace Violence Monitoring



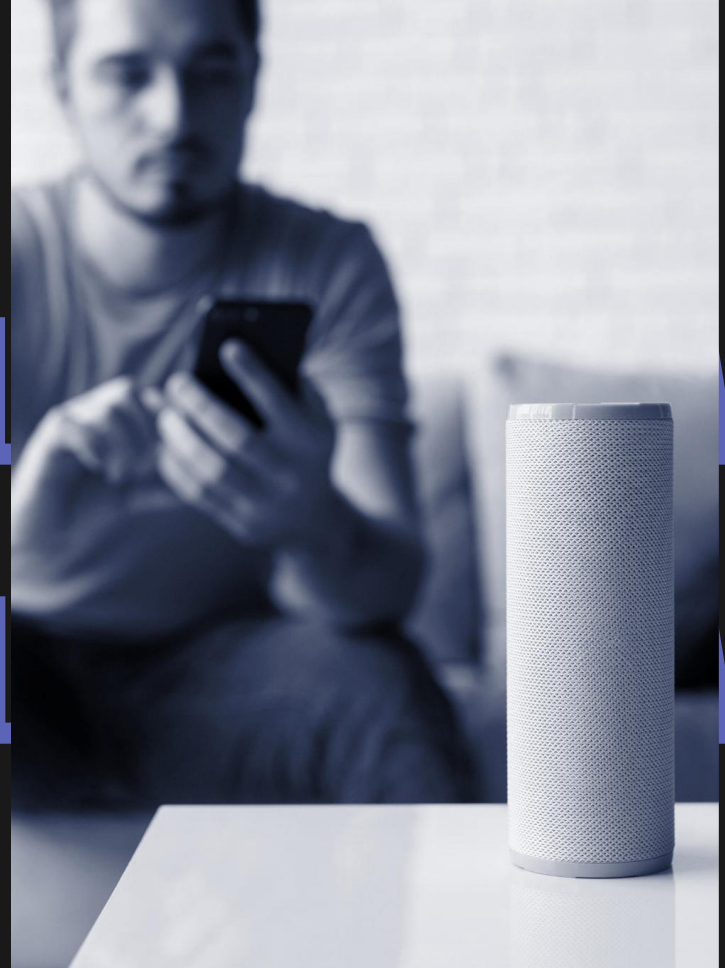
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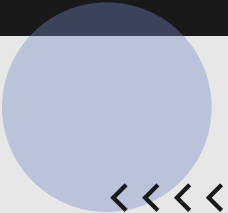
Workplace violence is a pervasive issue globally that poses a risk to workers' mental health. More than one in five people (almost 23 %) in employment have experienced violence and harassment at work, whether physical, psychological or sexual . AI can play an important role in preventing workplace violence. Natural language processing (NLP) is a technique from computer science that helps to analyze large bodies of text. Using NLP, AI can scan emails and files for inappropriate language, alerting managers when such phrases are detected . With voice recognition, AI can recognize spoken phrases in meetings, generating detailed reports to address instances of harassment .

6. AI in Drug and Alcohol Screening Programs

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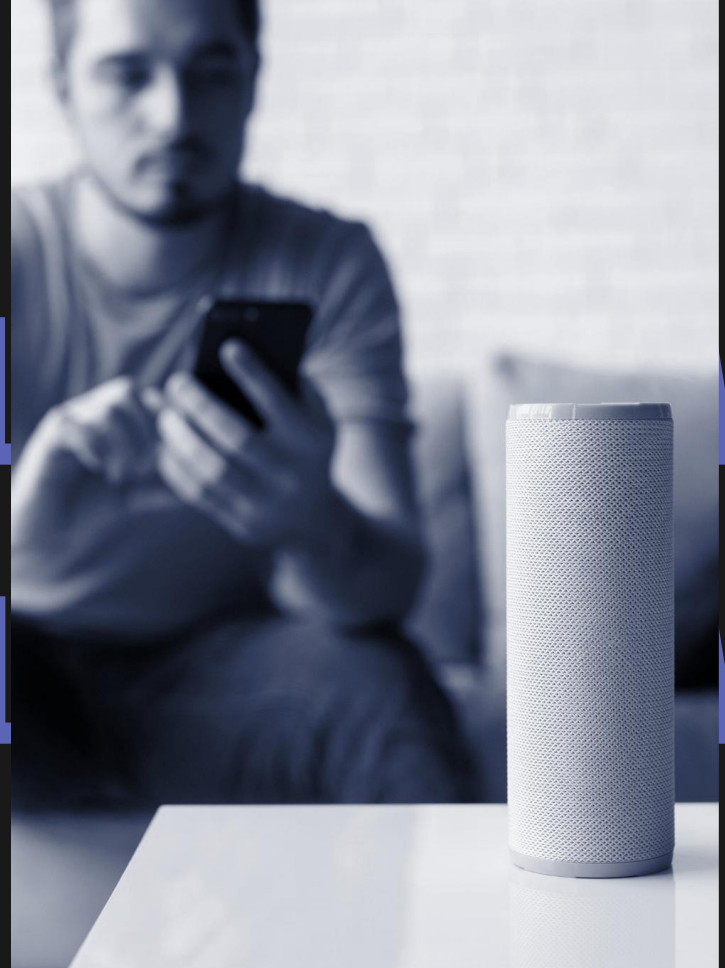
About 60% of people with substance use disorders (SUDs) are currently employed. Therefore, workers' alcohol and drug use can have a detrimental impact on workers and the workplace, resulting in absenteeism, high turnover, reduced productivity, and other safety issues .Artificial intelligence can help make drug and alcohol screening processes in the workplace more efficient and accurate .AI systems can analyze biological samples, ensuring a drug-free workplace through compliance with safety regulations.



7. Workforce Mental Health Monitoring



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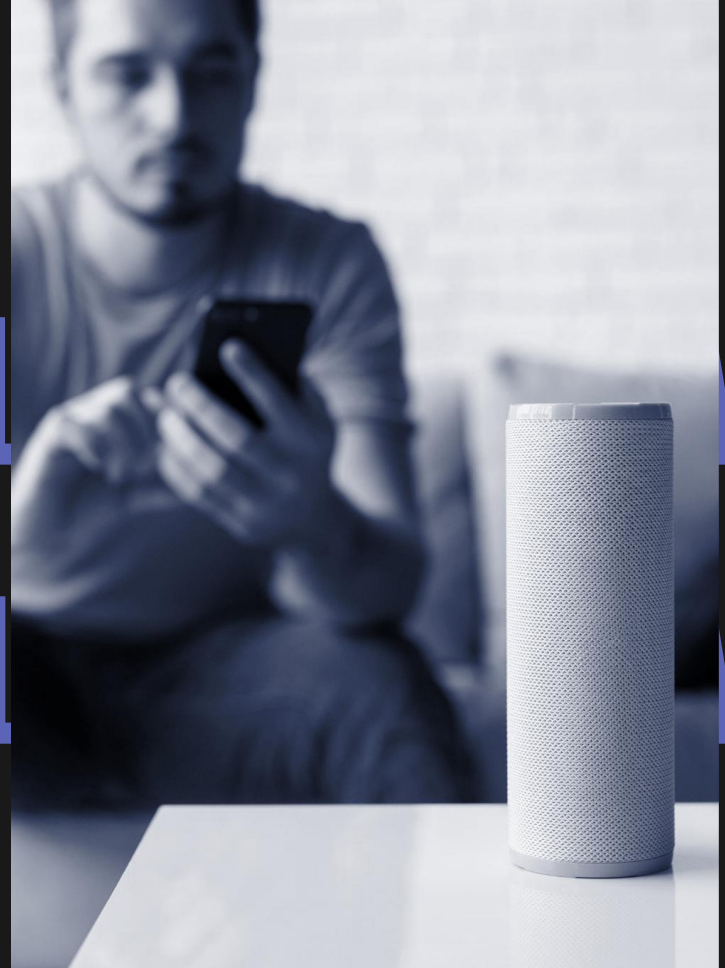




AI-driven tools are increasingly employed for monitoring and addressing mental health issues in the workplace, which can be done using remote health monitoring systems **by tracking vital signs and health metrics** and providing real-time information to healthcare professionals for early detection of health issues among workers. In addition, **NLP** can play a role in **analyzing workers' communication** for signs of stress, enabling timely interventions and support. This enables organizations to implement preventive measures to support workers' mental health and well-being.

8. Musculoskeletal System and Ergonomics

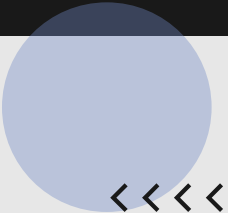
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The work-related musculoskeletal disorders (WMSDs) are considered an important cause of occupational injury at the workplace, leading to increased absence rates from work .On the other hand, ergonomics can defined as adjusting work environments, tools, and worker postures to prevent WMSDs induced by ergonomic risk factors such as awkward posture, repetitive movements, and excessive force at work . Ergonomists usually assess each worker's ergonomic risk factors using techniques such as postural analysis, anthropometric measures, motion and time studies, biomechanical models, force evaluation, and energy expenditure assessments.

Recently, several studies have shown the possibility of improving ergonomic analysis through the combined use of artificial intelligence and wearable sensors . AI-assisted health programs can analyze ergonomic factors and individual anthropometric data to predict and prevent musculoskeletal disorders in the workplace.

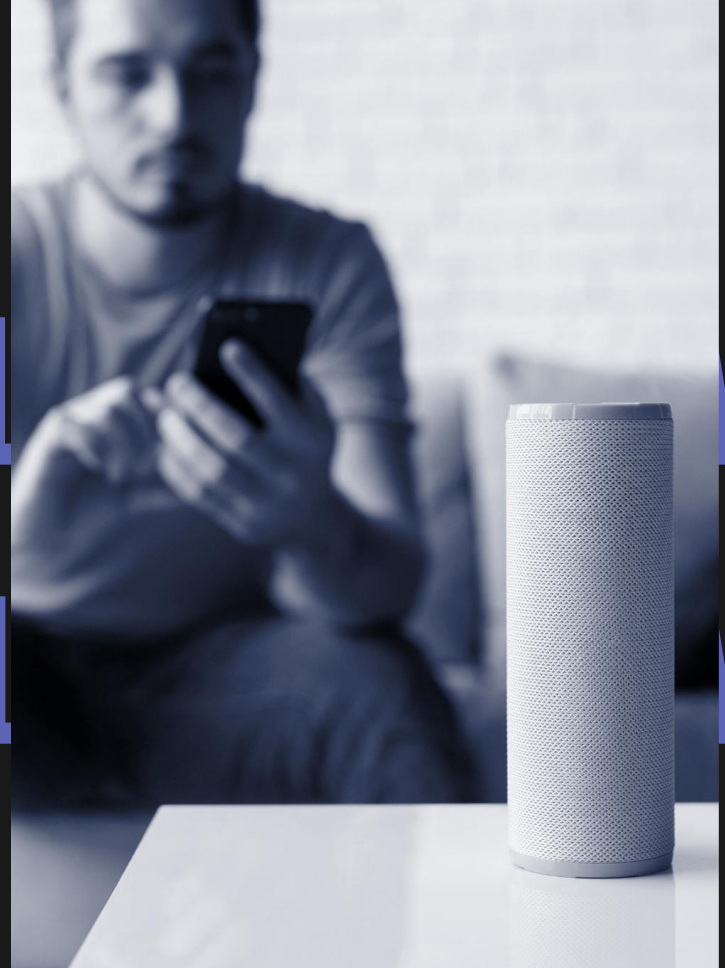
AI-driven wearable devices can continuously analyze workers' motions and body postures to recognize movements that may pose a risk of injury. Alerts are then issued to workers to mitigate the potential for long-term health problems.



9. Automating Dangerous Tasks Using AI Automated Bots



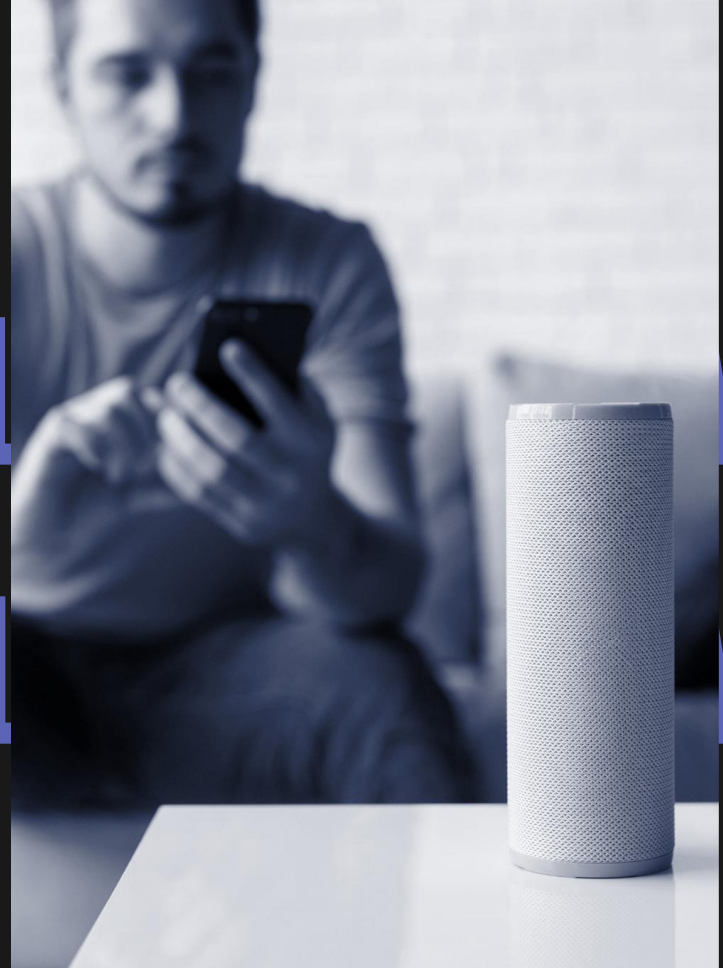
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Bots, short for robots, are automated software programs designed to perform specific tasks. The most important bots used in industry are collaborative robots (Cobots) and Chatbots. Collaborative robots, often referred to as cobots, are designed to work in close proximity to humans, fostering a collaborative and cooperative environment.

11. Drawbacks and Challenges of AI in Occupational Health and Safety

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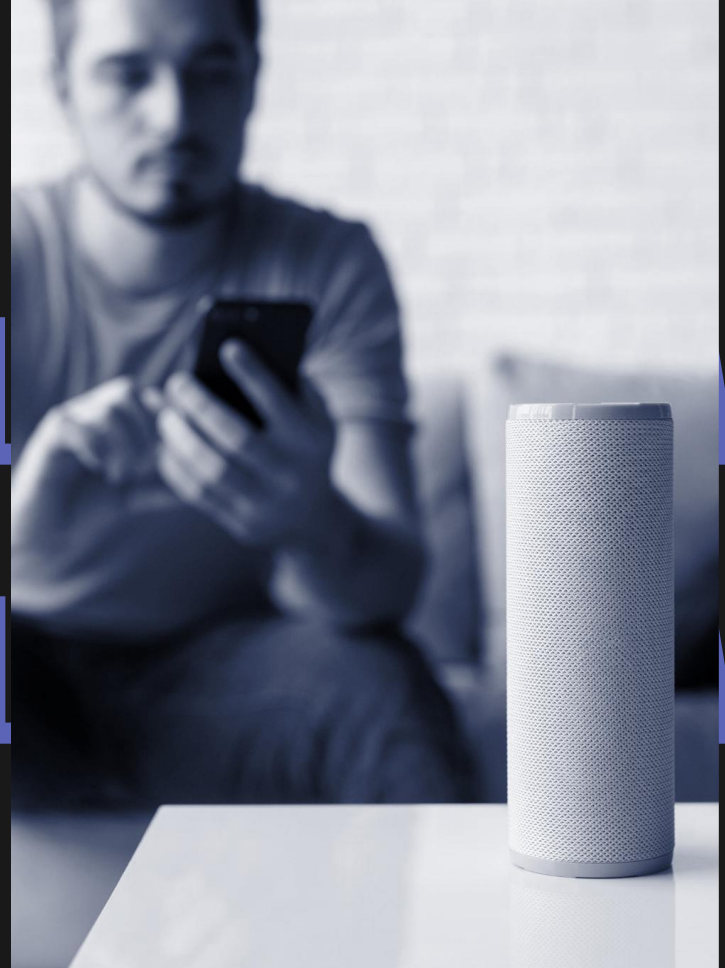




Despite AI's immense potential to enhance workplace safety, its implementation brings challenges and ethical issues. Developing and implementing AI systems can be expensive and may require significant investment in hardware, software, and training .High-quality data is essential for AI to make accurate risk assessments and envisage effective recommendations. If the data used is incomplete, outdated, or inaccurate, it can significantly impact the performance of the AI system, which could result in erroneous predictions and potentially lead to safety hazards.

12. AI-Related Ethical Issues at the Workplace

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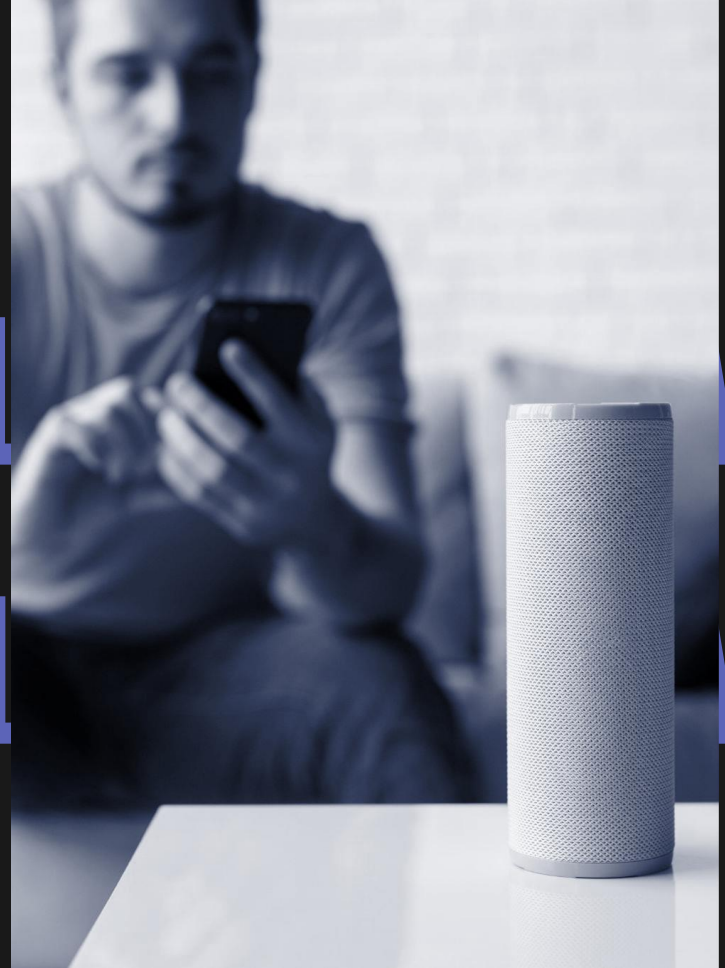


Artificial intelligence can potentially revolutionize health and safety practices, introducing **ethical considerations** that must be addressed. Critical ethical issues include **ensuring privacy and data security**, given that AI systems rely on **extensive datasets containing personal information** such as wearable devices and sensors.

So, it is essential to guarantee this data's ethical and secure collection, utilization, and storage. Additionally, concerns arise regarding biases and discrimination inherent in AI systems stemming from the data on which they are trained, leading to potential unfair or discriminatory decision-making . Furthermore, the automation capabilities of AI raise apprehensions about job displacement, prompting considerations about the necessity for safety professionals to acquire new skills in response to evolving tasks.

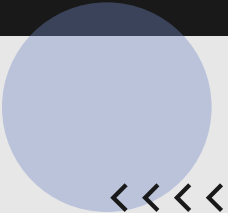
13. AI-Impacts on Worker's Mental Health

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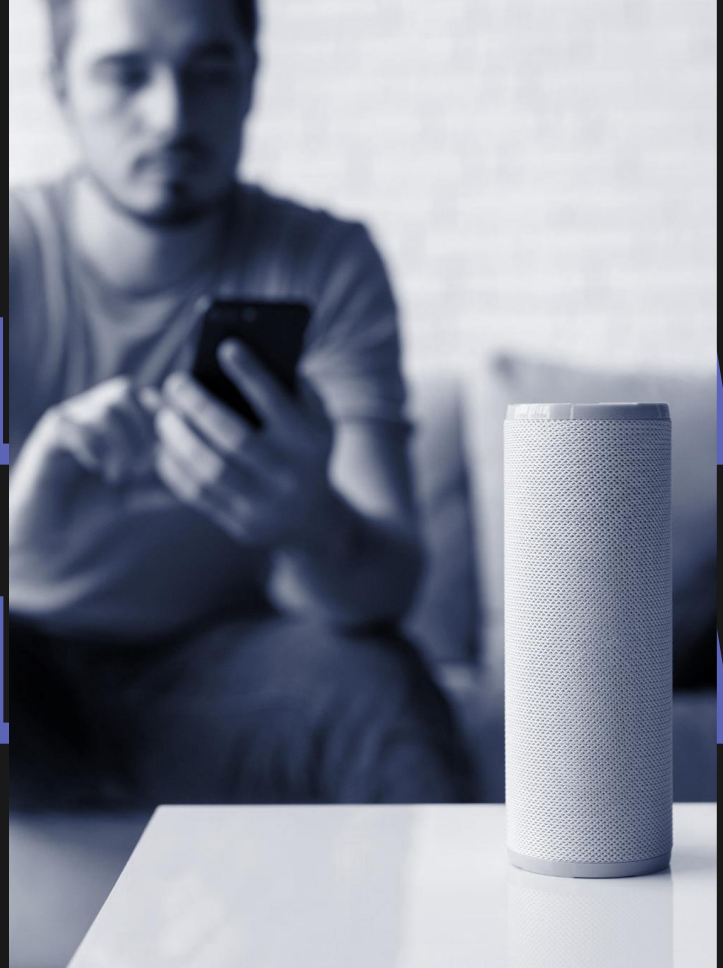
Integrating AI into health and safety can negatively impact workers' mental health, including anxiety and stress related to job automation or the possibility of AI errors leading to accidents. Employees may feel a loss of control in an environment monitored by AI systems, experience isolation and disconnection from human colleagues when interacting more with AI, and feel a diminished sense of meaning and purpose when their tasks are automated by AI.



Conclusion



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In conclusion, integrating AI in occupational health and safety offers benefits such as enhanced safety and productivity through predictive maintenance and real-time risk assessment. However, drawbacks include ethical concerns, data privacy considerations, and the need for regulatory compliance. Work organizations must balance innovation with respecting workers' rights, investing in workforce education, building AI expertise, and collaborating with solution providers to seamlessly ensure a safe workplace that integrates AI and human ingenuity.



Thank you