# OCCUPATIONAL SAFETY WITH AI
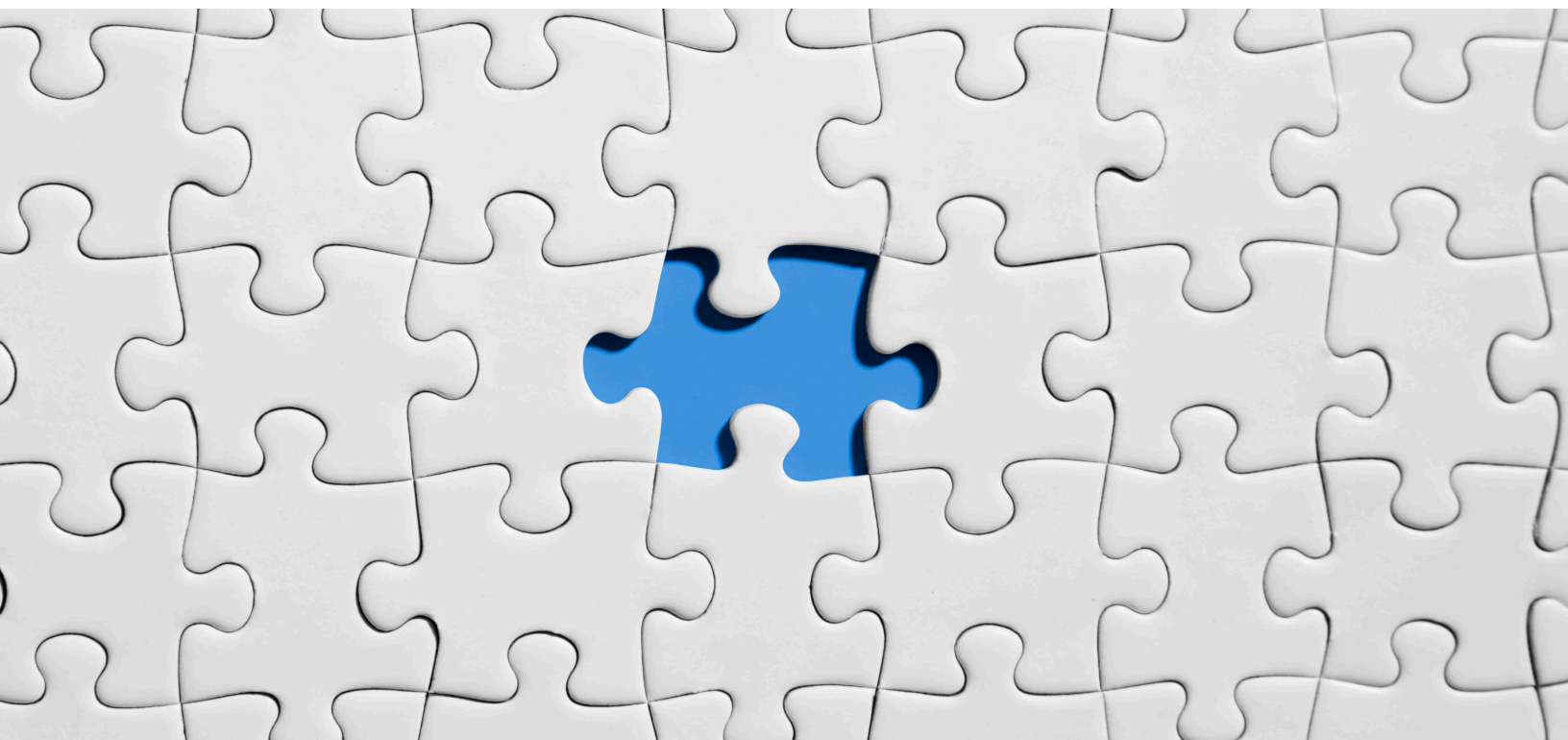
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# Abstract

Artificial intelligence (AI) refers to the simulation of intelligence in machines that are built to perform tasks that typically require human intelligence or intervention. The Internet of Things (IoT) is good at collecting data via sensors and devices which monitor multiple factors and provides output based on the actuators. The problem lies in analyzing this data fast enough to act on the data received to ensure the safety of the people working in hazardous environments.

Ensuring safety is critical for any occupation or workplace and with AI we overcome many challenges in ensuring safety that were due to human mistakes. This article focuses on using AI technology to bridge the gap by analyzing data in real-time and provide meaningful output like a system of warnings to ensure workplace or occupational safety. We will discuss methods of implementation of this technology in various industries and the advantages and disadvantages of using AI to ensure Occupational Safety.

## Introduction

The World Health Organization (WHO) states "occupational health deals with all aspects of health and safety in the workplace and has a strong focus on primary prevention of hazards."

According to a recent report by the International Labour Organization (ILO), annually 2.78 million workers die from occupational accidents and work-related diseases (of which 2.4 million are disease-related) and around 374 million workers suffer from non-fatal occupational accidents. It is estimated that around 4 percent of the world's GDP constitutes lost workdays; in some countries, it extends to 6% or more.

Apart from the economic cost, there's an invisible cost, not fully identifiable in these figures, of the human suffering caused by occupational accidents and work-related diseases. This is incredibly tragic and, as proven by science, largely preventable.

Safety-related accidents are no different from everyday accidents. They could be due to any number of random incidents and bad luck, but it's most often due to:

- Human error
- Partial information
- Lack of preparation
- Working when unwell or poorly rested
- Neglecting safety procedures

AI has come a long way since Deep Blue (beating us in our own game). AI applications are intertwining with our life in every possible way. AI workplace safety isn't a futuristic idea, it's right around the corner and the question to be answered is – can we trust AI with our safety? Let's discuss the methods and how AI can help negate the reasons mentioned above for workplace-related accidents.

# Computer Vision – Basics

Computer Vision is a field of study often associated with AI and Machine Learning (ML) that aims to develop and implement techniques that help computers understand images or videos. Analyzing the data of digital images may involve distilling a description from the image, i.e. text, an object, a person, and so on. Computer Vision can be broadly be called a subfield AI and ML, which may involve the use of techniques borrowed and reused from a range of disparate engineering and computer science fields.

Following are some Computer Vision tasks:

- Object Classification – one or several pre-specified or learned objects or object classes can be recognized
- Identification – an individual instance of an object is recognized
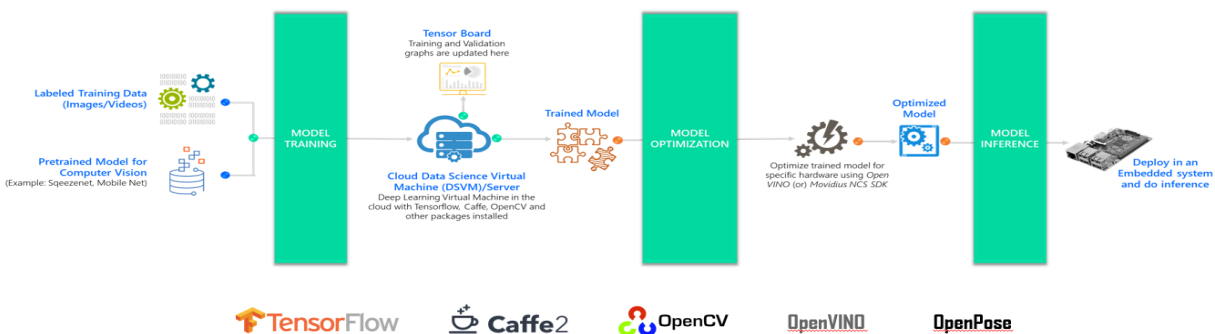- Detection – the image data are scanned for a specific condition



**Figure 1. Computer Vision Process Flow**

Figure 1 shows a usual process flow for training a Computer Vision model. Generating or collecting training data would be the first step in the process. The training data is then labeled. Labeling involves manually marking the objects in every image with labels. Most often the training is done on a cloud server because the training requires lot of processing power. The training can be monitored using a dashboard – called Tensor Board – that provides real-time visualization of the model training parameters. The trained model can be downloaded into a local machine. We can optimize the trained model can be optimized to efficiently run on small single-board computers. The hardware optimization is usually achieved by using optimization packages provided by respective hardware vendors. Finally, an optimized model can be uploaded onto an edge processor and run in low power units that can run the models and perform inference in real-time. The output of the model can be used for any number of applications.

# Healthcare industry

Healthcare workers are exposed to several hazards that may adversely affect their health and well-being. Long hours, changing shifts, physically demanding tasks, violence, and exposures to infectious diseases and harmful chemicals are samples of hazards that put these workers in danger for illness and injury.

In 2019, U.S. hospitals recorded 221,400 work-related injuries and illnesses, a rate of 5.5 work-related injuries and illnesses for every 100 full-time employees. This is almost twice the rate for private industry. The injury and illness rate in hospitals is above the rates in construction and manufacturing – two industries that are traditionally thought to be relatively hazardous.

Artificial Intelligence has huge potential within the healthcare industry, from identifying if procedures are followed to assisting in surgeries. Given the recent outbreak of COVID -19, there's an enormous emphasis on communicable disease control which may be achieved by wearing proper safety equipment such as masks and face shields. Hospital-acquired infections take many lives per year, many attributed to health care staff not following proper protocols after assisting a patient. The method for checking if protocols are followed are often difficult or sometimes, impossible. This is where AI can shine. Hospitals can make use of their existing cameras, and with the assistance of computer vision algorithms and AI models, check if the staff are following safety protocols.

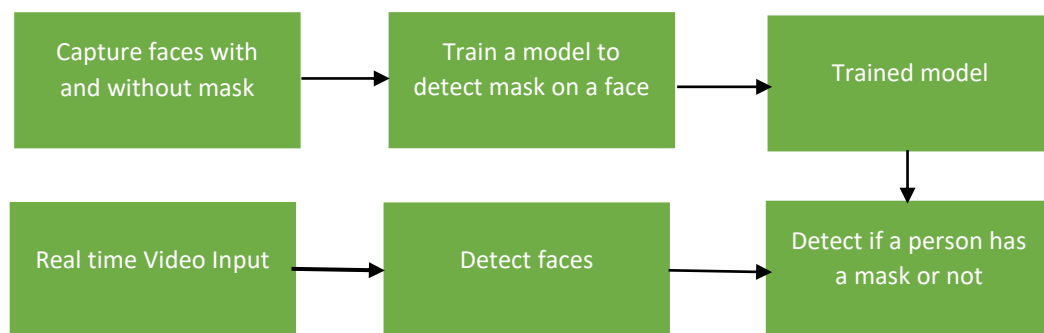Figure 2 shows a simple mask detection model workflow from Nvidia.



**Figure 2. Workflow for developing an AI-based face mask detector.**

The developer recipe (Figure 2) shows the high-level workflow of training a face detection model from the images of people with and without masks, and then how the real time video feed along with the trained model is used to detect if a person is wearing a mask or not.

# Construction industry

Construction is one of the most dangerous occupations in the world, with more occupational fatalities than any other sector in both the United States and the European Union. In 2019 9 Census of Fatal Occupational Injuries finds that 5,333 fatal occupational injuries in 2019 represents the largest annual number since 2007.  A worker died every 99 minutes from a work-related injury in 2019.  Fatalities among workers age 55 and over increased 8 percent from 1,863 in 2018 to 2,005 in 2019, which is the largest number ever recorded for this age group. Falls are one of the most common causes of fatal and non-fatal injuries among construction workers.

There is a range of potential hazards at the location, from dangerous structures to moving equipment that present dangers to humans. AI is now helping to enhance overall safety on job sites. Increasingly, construction sites are equipped with cameras, IoT devices and sensors that monitor many aspects of construction operations and inform staff whenever potential safety hazards are detected. This automated process is often repeated every minute and all unsafe events are logged. It also can train image classification models to detect the character of the activity being performed, i.e. bar bending, concreting, etc. This not only reduces liability but also can save lives and increase efficiency.

Below are a few other applications of AI with reference to safety in the housing industry

- Analyzing and tagging visual and audio data for safety hazards and unsafe practices
- Analyzing and tagging visual and audio data to record and make searchable best practices
- Identifying potential safety risks and hazards by location and other criteria supported, inspection data, safety observations, issues, checklists, photos, etc.
- Identifying Subcontractors with unsafe practices supported by jobsite data
- Identify the highest recurring safety risks and hazards across your jobsite supported by current and historical data
- Prioritizing targeted safety improvements by subcontractor, project or business unit level supported by recurring hazards and risks from present and historical data

Figure 3 shows a simple vest and helmet detection model using You Only Look Once (YOLO), a set of techniques for object recognition designed for real time analysis of the images for low latency requirements.
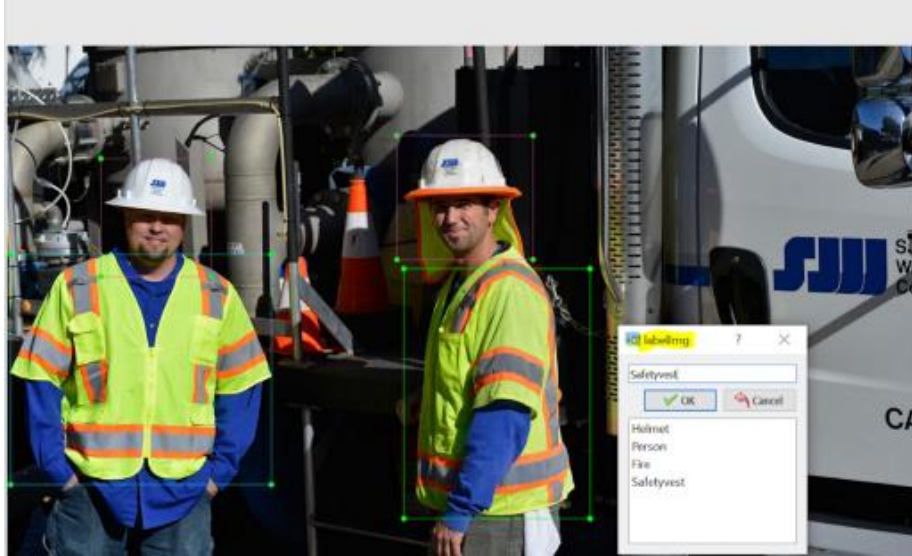
**Figure 3. YOLO detection Model**

# Mining Industry

Mining is crucial to the success of a country as it provides the basic elements needed for construction of various tools, from building materials on roads to iron and other minerals used in gadgets along with ornaments. It is also economically important to its country from an industrial perspective.

Along with all the advantages of mining, there are concerns as lives have been lost or affected by the dangerous process of mining, i.e. underground mining hazards associated with fire, flood, inrush, gas, vapors, dust, blasting, machinery, noise, heat, and airborne particulates which can be devastating to human life and the environment.

One way to overcome this issue is to have an automated system based on sophisticated AI and ML design, which would ensure that human intervention required during these ventures would be as low as possible. Another best practice is to monitor the current situation to constantly check for issues that may arise during operation and potential fixes to those issues.

This can be accomplished by the following:

Companies use sensors and databases to gather current and historical data about an area and then run that data through an AI program. Through application of predictive analytics, these programs can then tell what kinds of operations will be most effective from a cost and risk perspective. This kind of application can boost productivity by 10%, and those savings can equate to opening another entire mine.

Mining companies can apply these AI systems to improve current operations or open new ones. Predictive analytics can reveal potential places to start a new mine or direct work in an existing one.

Using such methodology would not only prevent loss of human life but also environmental harm that can be caused by over mining or using unstable methods.

## Conclusion

Saving lives with a technology that is readily available is not a hurdle but a step we can all take. In this article we studied how AI can improve occupational safety in different fields. Though AI has its challenges, it has great potential and a significant role to play in ensuring occupational safety.

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