THE ROLE OF SMART TECHNOLOGIES IN ENSURING THE SAFETY OF MINERS IN MINING EMERGENCIES

Kh. Nosirov,
M. Arabboev,
Sh. Begmatov,
Sh. Bobomurodov
Tashkent University of Information Technologies named after Muhammad
al-Khwarizmi, Tashkent, Uzbekistan

Abstract: Due to the development of information technology in the 21st century, the role of automation and smart technologies in various aspects of human life is increasing. The application of smart technologies in various fields is showing its effectiveness. One such area is the mining sector. The safety of life of the representatives of this industry is always important. The reason is that all the work is done underground, so there is a high probability of man-made emergencies. This paper reviews the issue of the role of smart technologies in ensuring the safety of miners in mining emergencies.

Keywords: Safety; mining; emergency; smart technology; smart helmet.

Smart technology is a technology that uses artificial intelligence, machine learning, and big data analysis to provide cognitive awareness to objects that were in the past considered inanimate [1]. Meanwhile, several companies around the world are developing smart technologies that will continue to improve mine safety standards. Things like smart devices and automation are now able to save lives in mines.

This paper presents essential four mining safety technologies based on smart technology. They are Worksite Simulators; Radio-Frequency Identification; Smart Helmets; Robots and Automation.

Worksite Simulators. Experience is important in mining. Therefore, at a time when coal mining was booming in some parts of the country a decade ago, there was a rush to train young recruits quickly. Currently, worksite simulators are being used to enhance the experience of newcomers to mining operations. One such simulator is offered by e-Tech Simulation. e-Tech Simulation has its own suite of training programs that can help new hires learn how to operate hydraulic excavators, off-highway trucks and any other heavy machine a worksite might call for [2].

Radio-Frequency Identification. For years, the most accurate way to establish the whereabouts of a miner was a headcount. Remote communication tools are very important in communicating with miners and identifying them in a mine. Research in recent years shows that RFID technology can be used to account for and locate underground miners. In [3], it is demonstrated how an RFID system can pinpoint where a miner is underground in real-time, trace the miner's movements, and generate attendance reports for safety performance recordkeeping.

Smart Helmets. One of the most important devices to ensure Miners' safety is the helmet. In recent years, modern helmets used in the mining industry are being developed. As technology advances, helmets are also becoming 'smarter'. A smart helmet is a wearable device that can able to detect hazardous events in the mines industry.

It is developed a smart helmet in [4]. The smart helmet for miners developed by Alireza [4] is shown in Figure 1.

Figure 1. Smart helmet for miners

There are 7 different gases in the fields, and the proposed device can detect more than eight hazardous gases. If workers approach toxic and dangerous gases, the helmet will alert them by warning them. As the distance of the miners to toxic gases is reduced, the intensity of the warning also increases. If the ambient temperature is greater than the tolerance of the human body (e.g., 45 degrees), the smart helmet will generate a different alarm tone. And this temperature is adjustable. If the work environment is dark, the headlight illuminates automatically. This lamp has a rechargeable battery and can be programmed to start it in codes. The proposed helmet is equipped with 3

ultrasonic sensor modules. Each of these sensors performs 50 times per second and scans all directions horizontally from a few centimeters to several meters. When each of these sensors detects an object in its path, the smart speaker system alerts you.

Robots and Automation. Automated mining involves the removal of human labor during the mining process [5]. The mining industry is moving to automation. This may still require a large amount of human capital, especially in developing countries, where there is little incentive to increase efficiency due to low wages. There are two types of automated mining - automation of processes and software, as well as the application of robotic technology in mining vehicles and equipment.

Conclusion

This paper presents an overview of four essential mining safety technologies based on smart technology. In our future paper, we also plan to develop a smart helmet as described in this paper.

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