Chapter 24
Artificial Intelligence, Machine Learning, and Autonomous Technologies in Mining Industry

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ABSTRACT

The implementation of artificial intelligence (AI), machine learning, and autonomous technologies in the mining industry started about a decade ago with autonomous trucks. Artificial intelligence, machine learning, and autonomous technologies provide many economic benefits for the mining industry through cost reduction, efficiency, and improving productivity, reducing exposure of workers to hazardous conditions, continuous production, and improved safety. However, the implementation of these technologies has faced economic, financial, technological, workforce, and social challenges. This article discusses the current status of AI, machine learning, and autonomous technologies implementation in the mining industry and highlights potential areas of future application. The article presents the results of interviews with some of the stakeholders in the industry and what their perceptions are about the threats, challenges, benefits, and potential impacts of these advanced technologies. The article also presents their views on the future of these technologies and what are some of the steps needed for successful implementation of these technologies in this sector.

INTRODUCTION

Mining plays an important role in the world economy. In 2016, revenue from the world's leading mining companies was US$496 billion (Statista, 2018). The mining and extractions industry employed around 756,000 people in the US in 2016 (DOE, 2017). After being on the decline for the last few years, the mining industry is growing again and investment in the mining sector is increasing (Deloitte, 2017). One factor that can boost the growth of mining sector and make it more lucrative to investors is the application of Artificial Intelligence (AI), machine learning, and automation to improve the technological, economic, and environmental outlook of the industry.

AI and machine learning are two technologies that have the potential to change the technological framework of the future and both rely heavily on big data manipulation and analytics (Marr, 2016; Wang and Siau 2019). In 1956, John McCarthy defined artificial intelligence as the capacity of machines to behave intelligently. Machine learning is based on computational algorithms that are designed to emulate human intelligent by learning from the surrounding environment utilizing big data provided to them (El Naqa & Murphy, 2015). In this paper, we have discussed the use of AI, machine learning, and autonomous technologies in the mining industry and how it can help in a new mining revolution.

CURRENT APPLICATIONS OF AI AND AUTONOMOUS TECHNOLOGY IN MINING INDUSTRY

The following are the sectors of the mining industry in general and mining operations in particular that are experiencing increased applications of AI and autonomous technologies. Figure 1 also shows some of the sectors where the implementation of these technologies is underway.

Prospecting and Exploration

Prospecting is the first stage of looking for an economic mineral deposit and evaluating this deposit in terms of current economic and market conditions to ascertain if further investment is viable for the given prospect or not. Prospecting involves reconnaissance of the area of interest, collection of geophysical, geological, and economic data. Exploration involves sampling, laboratory work, borehole logging, and further investigation of prospect (Böhmer & Kucera, 2013). Both these stages involve extensive collection and use of data, and with the use of traditional methods involving human labor, site visits of remote areas, manual sampling and assaying, and primitive techniques can last a period of two years to twenty years before the actual worth of the deposit is established (Böhmer & Kucera, 2013).

Prospecting generally starts with finding an anomaly in the structure, lithology, geological features, and plantation and plant growth patterns using maps, aerial photographs, satellite images, and other available data. AI systems and data analysis software can be fed with geological, topographical, mineralogical, and mapping data and can be used to pinpoint the anomalies and variances in the data and to locate areas of potential interests. Some research in this field is already underway and one such system is being utilized on an experimental basis by Goldspot Discoveries Incorporated for gold discovery. Similarly, Goldcorp and IBM Watson are working together to sift through large geological data to improve the accuracy of targeting mineable prospects (Walker, 2017).

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