

# Artificial Intelligence, Machine Learning, Automation, Robotics, Future of Work and Future of Humanity: A Review and Research Agenda

Weiyu Wang, Missouri University of Science and Technology, USA

Keng Siau, Missouri University of Science and Technology, USA

## ABSTRACT

The exponential advancement in artificial intelligence (AI), machine learning, robotics, and automation are rapidly transforming industries and societies across the world. The way we work, the way we live, and the way we interact with others are expected to be transformed at a speed and scale beyond anything we have observed in human history. This new industrial revolution is expected, on one hand, to enhance and improve our lives and societies. On the other hand, it has the potential to cause major upheavals in our way of life and our societal norms. The window of opportunity to understand the impact of these technologies and to preempt their negative effects is closing rapidly. Humanity needs to be proactive, rather than reactive, in managing this new industrial revolution. This article looks at the promises, challenges, and future research directions of these transformative technologies. Not only are the technological aspects investigated, but behavioral, societal, policy, and governance issues are reviewed as well. This research contributes to the ongoing discussions and debates about AI, automation, machine learning, and robotics. It is hoped that this article will heighten awareness of the importance of understanding these disruptive technologies as a basis for formulating policies and regulations that can maximize the benefits of these advancements for humanity and, at the same time, curtail potential dangers and negative impacts.

## KEYWORDS

Artificial Intelligence, Automation, Future of Humanity, Robotics

## INTRODUCTION

With the rapid advancement in artificial intelligence (AI), machine learning, automation, and robotics, many jobs are at risk of being replaced by AI and AI-based automation technology. Job replacement, however, is not a new phenomenon. The loss of jobs caused by technological change is termed “technological unemployment” (Peter, 2017). Some jobs, that have disappeared as technology has advanced, include switchboard operators, elevator operators, and typists. The disappearance of

DOI: 10.4018/JDM.2019010104

obsolete jobs that have been replaced by technologies, is referred to as “technological job obliteration,” each time an industrial revolution has occurred, people have been concerned about technological unemployment and technological job obliteration.

The steam engines in the first industrial revolution resulted in the transition from manual production to a machine industry. Many manual agricultural jobs were replaced by machines. The second industrial revolution enabled mass production by employing electric power and improving job automation, while the third industrial revolution further improved automated production by using electronics and information technology. With the development of AI and machine learning, as well as a fusion of technologies (such as the Internet of things, big data, robotics, virtual reality, 3-D printing, and quantum computing), the fourth industrial revolution has arrived (Bloem et al., 2014). These technologies are blurring the lines between physical, biological, and digital spheres. Further, the speed of technological breakthroughs has no historical precedent. What are the differences between this time and the past industrial revolutions? What about the future of work and humanity? In the past technological revolutions, the physical strength and speed of humans were overtaken by machines. In the fourth industrial revolution, not only are a human’s physical strength and speed inferior to machines in certain jobs, but a human’s cognitive abilities in some fields are also surpassed by machines. The latter makes the fourth industrial revolution particularly disturbing and unsettling.

According to a Pew Research Center survey, 63% of participants were hopeful that the expanding role of AI would leave us better off, but they worried that AI would negatively transform and affect society at the same time (Mack, 2018). The focus of this research is to analyze the impact of AI, machine learning, automation, and robotics, and their effect on the future of work and humanity. This article is structured as follows: the next section provides introductions to AI, machine learning, automation, and robotics. Then, we analyze the promises and benefits provided by these technologies. Challenges posed by these technologies are also discussed. Finally, a research agenda is proposed that emphasizes the need for academia, industry, and government to pay attention to and prepare for these rapidly advancing technologies.

## **Artificial Intelligence (AI)**

AI is an umbrella concept that influences and is influenced by many disciplines, such as computer science, engineering, biology, psychology, mathematics, statistics, logic, philosophy, business, and linguistics (Buchanan, 2005; Kumar et al., 2016). AI can encompass anything from Apple Siri to Amazon Go, and from self-driving cars to autonomous weapons. Generally, AI can be classified into weak AI and strong AI. Weak AI, also known as narrow AI, excels in specific tasks. Most advancements in AI, that have been achieved to date, can be classified as weak AI, such as Google Assistance and Alpha Go. Researchers from different domains are, however, competing to create a strong AI (also called human-level artificial general intelligence or artificial super intelligence), which will process multiple tasks proficiently. A strong AI is the controversial and contentious concept. Many transhumanists believe that a strong AI can have self-awareness and become the equivalent of human intelligence. Once a strong AI becomes a reality, an intelligence explosion will be precipitated and technological singularity may be unavoidable. Superintelligence may emerge almost immediately after that (Müller & Bostrom, 2016). Superintelligence can be loosely defined as “any intellect that greatly exceeds the cognitive performance of humans in virtually all domains of interest” (Bostrom, 2014, p. 22). In other words, a strong AI would be able to outperform humans in nearly every cognitive task.

## **Automation**

According to the Google dictionary, automation is the use of automatic equipment in a manufacturing system or other production process. In Wikipedia, automation is defined as “the technology by which a process or procedure is performed without human assistance.” Basically, automation is a system or technology that automates some work that was previously done by humans. Parasuraman and Riley (1997, p. 2) defined automation as “the execution by a machine agent (usually a computer) of

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