Chapter 14
Machine Learning and Blockchain Integration in Industrial Robotics: Challenges and Opportunities

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ABSTRACT

Machine learning and blockchain have the potential to completely change the landscape of industrial robots. Learning and adaptation give robots an edge in functionality and independence. Blockchain, on the other hand, provides a decentralized and secure platform for information exchange and transaction verification. In this chapter, the authors look at the potential benefits and drawbacks of integrating machine learning and blockchain technology for use in manufacturing robots. The study begins with a brief introduction to machine learning, blockchain, and their respective industrial robot applications. Some of the possibilities and advantages that will be covered in the next sections include better data security, more transparent and auditable decision making, and the use of decentralized control systems. The importance of collaboration between academic institutions, businesses, and government agencies is emphasized in order to speed up the process of mainstreaming machine learning and blockchain integration in industrial robots.

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INTRODUCTION

In recent years, industrial automation has entered a new phase thanks to the confluence of cutting-edge technology. Machine learning and blockchain in particular have the potential to radically alter the landscape of industrial robots. This chapter discusses the benefits, drawbacks, and possibilities of combining machine learning and blockchain technology in industrial robots systems. Robots' capacity to make decisions is improved by machine learning because of the data it can sift through and the way it can adjust on the fly. The blockchain, on the other hand, is a decentralized digital ledger that is both immutable and transparent, making it an ideal system upon which to build a trustworthy data and transaction management infrastructure. Together, they form a formidable duo, promising heightened efficiency, transparency, and security across various industrial domains.

A robot is a sophisticated, programmable entity designed to mimic the functions of living organisms. It's adept at executing intricate and recurrent tasks. Robots are primarily classified based on their movement capability into two groups: stationary robots and mobile robots. Mobile robots further branch out into three types: those that move on wheels or legs, those that fly, and those that navigate underwater. The latter utilize water thrust for movement. In this section, we'll focus solely on robots with wheels(Verma, 2022). In contemporary robotics, the term "agency" is prevalent. An agent is either software or hardware that enables a robot to achieve a specific objective. Just as humans pool resources when confronted with complex challenges, robots sometimes require the combined intelligence of multiple agents to reach their goal. These agents can detect and act logically. At times, agents might share data or decisions with their counterparts either via direct communication systems or through distinct gestures, serving as communication cues to their peers.

Communication is essential for agents to create plans. Yet, due to the time-intensive nature of communication, it's often sidelined in real-world robotic applications. In this thesis, we explore a learning-based approach to discern agent behavior patterns, reducing communication lags in real-time planning.

The field of computer science has witnessed a constant evolution, encompassing everything from lightning-fast computations to the emergence of intelligent, self-sustaining systems. These advancements have rippled through numerous related domains, including biomedical engineering, aerospace engineering, and more(V. Kumar, B. Pant, G. Elkady, 2022). Among these interdisciplinary fields, robotics has recently taken center stage in the scientific community. Robotics draws upon a multitude of technological resources from diverse disciplines, and one such rapidly evolving and transformative asset is blockchain technology.

When it comes to transactions, blockchain technology, a P2P electronic record management system, enables authentication and validation. It does this by functioning as a decentralized ledger and doing away with the necessity for a trusted third party. The ledger of past trades is a growing set of documents called "blocks," which are linked cryptographically. Blockchain's overwhelming acceptance may be traced back to its resilient byzantine fault-tolerant consensus process and distributed ledger design(R. Kavitha, K. Prasad, 2023). Any fraudulent transactions may be quickly identified and removed from the system since every node has a complete and accurate copy of the block chain.

In parallel, researchers have extended the applicability of blockchain beyond its original purpose in Bitcoin and finance sectors, now embracing its potential within the realm of robotics. This integration aims to create a more dependable, secure, and adaptable environment for robots, whether they function collaboratively or independently.