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AI and Blockchain in Enhanced COBOT Technologies

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Abstract

The combination of Artificial Intelligence (AI) and Blockchain technology has enabled dramatic advances in the field of collaborative robotics (cobots). This article investigates the synergistic integration of AI along with Blockchain in cobot technologies, with the goal of improving capabilities, productivity, and security. This study contributes to the existing discussion about the intersection of AI and Blockchain providing an understanding of possible applications, problems, and advantages of their combined deployment in cobot technologies. The conclusions provided in this work have implications for researchers, technicians, and industry experts who want to fully realise the promise of intelligent automation while being secure and transparent.

Keywords: Artificial Intelligence, cobot technologies, Blockchain

1. Introduction

Artificial intelligence (AI) systems share a common goal: to approximate human intellect and provide an objective approach to making decisions or performing tasks in a human-like manner. Blockchain is a distributed database system. All the details in the database and the network have complete data transparency since processes are observed and monitored continuously by all participants. Blockchain, AI, and robotics represent a trio of the most inventive and captivating technologies of the modern era. Many firms actively utilize them, building on their concepts to produce revolutionary products. Blockchain technology is rapidly evolving, and it may be integrated with a various systems, including robotics and AI applications. Cobots are being transformed from science fiction into reality through machine

learning. The incorporation of AI and blockchain with advanced cobot technologies has the potential to revolutionize several sectors. Blockchain technology can be useful in robotic situations because it provides an immutable registry of events and decentralized data [1].

AI makes it easier for everyone to program or parametrize robots. Perhaps in the future, no computer software will be required at all. With Blockchain, a new large database might arise that is not dominated, controlled, or driven by a few firms. Previous research has demonstrated that technologies evolve rapidly when they may be utilized and freely changed by as many individuals as possible. The use of AI algorithms within cobots promotes adaptive learning, allowing them to interact smoothly with human operators while dynamically reacting to changing tasks. This flexibility improves productivity and collaboration in human-robot settings [2][3].

The expanding use of cobots for manufacturing purposes is transforming sectors worldwide, revolutionizing production lines and opening up new opportunities. Gone are the days when industrial robots were confined to cages and segregated from human workers. Cobots are designed to work with humans, complementing and enhancing their strengths. The proposed architecture integrates AI's intelligence with Blockchain's decentralized ledger to build a safe and intelligent cobot environment. This tackles important issues including data privacy, reliability, and interoperability. The combination of AI and Blockchain within cobot technologies not just drives automation to new heights, but also lays the groundwork for the ethical and safe integration of intelligent robots across several sectors.

2. COBOT

A collaborative robot, or cobot, is a type of industrial robot that can work safely alongside people in a shared workspace. Autonomous robots, on the other hand, are hard-coded to do a single job repeatedly while remaining immobile. These machines focus on repetitive activities like inspection and picking, allowing people to focus on tasks that need problem-solving abilities. Because they are functioning alongside humans, they operate at a slower speed and contain sensors that instruct the machine to slow down instantly if a person makes touch with it.

A. Advantages of COBOT

- These robotic technologies have transformed the field of automation. One of the primary advantages of cobots is the fact that they have made robots accessible to entrepreneurs of all sizes who previously lacked the resources to adopt them. This is because cobots are adaptable and can be reconfigured to do different tasks based on the demands.

- Collaborative robots may function throughout all times, improving total production efficiency and productivity. They can conduct repeated activities with great accuracy and consistency, reducing mistakes and enhancing the quality of the manufactured goods.

- Cobots complete jobs properly, resulting in constant product quality. They use sensors and visual systems to identify problems, perform inspections, and perform real-time modifications.

- Cobots are meant to function in close proximity to people, eliminating the need for security measures. Their built-in sensors are capable of recognising and reacting to human presence, lowering the likelihood of an accident.

- Cobots are inexpensive, accessible with SMEs, and need few infrastructure changes. They consume less energy, need less maintenance, and provide a high ROI, resulting in cost savings and greater profitability.

B. Industrial Robot Vs Collaborative Robot

The Table.1 illustrates the comparison between the Collaborative and the Industrial Robot

Table 1. Industrial Robot Vs Collaborative Robot

Collaborative Robot	Industrial Robot
Cobots are designed to operate alongside people and have built-in safety measures such as force as well as torque sensors that detect	To avoid accidents with people, traditional industrial robots typically remain behind safety cages and barriers.

human presence along with stop or slow down when they come into touch with an operator.	
Inherently constructed with safety features like as sensors, lightweight materials, as well as rounded edges to reduce the danger of damage during human cooperation.	Additional safety precautions, like as fence or guarding, are required to keep them distinct from human workers.
Generally, easy to program and implement. Many cobots are designed for being user-friendly, and a few may even be developed by non-experts utilizing simple interfaces.	Often need specialized programming abilities and knowledge. Programming industrial robots may prove more complicated and time-consuming, necessitating a greater degree of technical expertise.
In general, they are less expensive than industrial robots. Smaller organizations may find the whole cost of adoption, including programming as well as integration, less expensive.	Typically have greater upfront expenditures, with further charges for safety measures, computer programming, and integration.

2.1 COBOT and AI integrated with Blockchain

The combination of collaborative robots, AI, as well as blockchain technology can result in a more intelligent, safe, and efficient production environment [4]. This combination offers advanced capabilities that include predictive maintenance, intelligent decision-making, overall accessible supply chain management, which all contribute to higher production efficiency and dependability.

A. Benefits of AI and Blockchain Integrated with COBOT

- AI algorithms may be used in cobots to improve their vision systems. This enables cobots to recognize and handle a broader range of items, increasing their versatility to various jobs.

- AI systems may use data from cobots to forecast when maintenance is required. This aids in scheduling maintenance tasks before to a failure, saving downtime and increasing the useful lifetime of the cobots.

- Blockchain technology can improve the security of data created by cobots as well as AI systems. It maintains the integrity and security of critical information, such as creating data and maintenance records.

- Blockchain can help to build a secure and easily accessible supply chain. Each stage of the manufacturing process, through raw materials to finished product, may be documented on the blockchain, resulting in a verifiable and immutable audit trail.

- Blockchain can help comply with regulatory compliance standards by maintaining an immutable record of operations and transactions. This may make the auditing process easier and guarantee that manufacturing activities meet industry requirements. Figure 1 illustrates the benefits of Collaborative ROBOT with AI and Blockchain

Figure 1. Benefits of Collaborative ROBOT with AI and Blockchain

3. Literature Review

The Table.2 summarizes the literature reviewed with the key findings and the limitations identified**.**

Table 2. Literature Review

Title	Summary	Findings	Limitations
[5]	Robots are a potential technology for performing several duties to assist various goals in the quarantine area.	The suggested architecture improves the intelligence, decentralization, and autonomy of networked multi-robot collaboration in a blockchain network.	Challenges include managing blockchain lifecycles, guaranteeing quality of data from new robots, analysing robot sensing skills, the possible impact increasing complexity on resources, and future research prospects in outdoor as well as hospital delivery systems.
[6]	Cobots are being transformed from imagination to science via machine learning.	The primary conclusions include the growing significance of artificial intelligence for cobots in industrial applications, the current market evaluation of collaborative robots, and the obstacles and future prospects for industry collaborative robots.	-
[7]	The suggested architecture has a wide range of applications, including manufacturing, network control, and robot control.	The suggested architecture for robotic control, which uses blockchain as a ledger as well as smart-contract technology, is modular and can be utilised in a variety of situations, making it easy to integrate, modify,	he suggested architecture has not yet been deployed or tested in actual robotic contexts. The study does not give empirical data to support the suggested architecture's usefulness in real applications.

		maintain, and extend to new domains.	
[8]	AI-powered blockchains provide auto-coding features for smart contracts, transforming them into intelligent contracts.	The paper's major findings include a proposal for an AI-Powered Blockchain that includes an auto-coding capability for smart contracts, which leads to improved security than regular smart contracts, and a contribution towards the field of vehicular networks utilising AI.	The study's limitations include security and privacy issues in IoV communication, blockchain complexity impeding mass adoption, vulnerabilities within smart contracts resulting in major attacks along with losses, and a lack of additional information on specific limitations or recommendations for future research.
[9]	A new architecture may monitor the environment, gather data, analyse it, process it with an AI-expert engine, make predictions and actionable consequences, and then publish it to a public blockchain platform.	The system also illustrates the viability of employing low-cost, low-power devices to fulfil AI and blockchain needs in a network comprising a few hundred nodes.	The constraints stated in the research are data security, system performance, and accuracy of predictions.
[10]	AI uses acquired data to deliver cognitive functions to robots.	According to the research, blockchain can propel different aspects of AI, such as data, algorithms, and processing power, to new heights.	-

4. Application of Implementing Collaborative Robots

Pick and Place: Cobots are skilled in picking up and placing goods in specific spots. This is especially beneficial in material handling activities, where they may collaborate with humans to carry things between workstations.

Packing: Collaborative robots can help in packaging as well as organising activities. They can package items, stack them on pallets, and even help prepare shipments for delivery.

Testing and Measurement: Cobots may be incorporated into testing and measuring procedures, allowing them to take exact measurements or test items. This guarantees consistent quality control.

Collaborative Workstations: Cobots are meant to operate securely in close proximity to people. This qualifies them for shared workstations, in which they may cooperate with human operators in real time, increasing flexibility and adaptability in production operations.

Ergonomics and Safety: Another key advantage of cobots is their ability to improve workplace safety as well as ergonomics. Cobots automate repetitive especially physically demanding operations, lowering the risk of muscular disorders and other manual labor-related accidents. To guarantee safe engagement with human workers, collaborative robots include safety features that include force-sensing technology, detection of collisions, and speed limits.

5. Challenges in Implementing COBOT

- **Task Complexity:** Cobots thrive at repetitive and well-defined activities, but they might struggle with complicated or unexpected operations. Assessing job complexity and knowing the cobot's limits is critical to ensuring that it is appropriate for the intended uses.
- **Infrastructure Integration:** Collaborative robots must fit easily into the current production infrastructure. To enable smooth interaction among robots and other

machines, workstations may need to be modified, procedures redesigned, or new communication systems implemented.

- **Safety Considerations:** Cobots are compatible with the smart industry idea and hence capable of saving data. Monitoring cobot performance and analysing the data is critical. Creating an organized maintenance plan and applying data analysis tools enables users to forecast breakdowns and increase overall efficiency.

- **Ethical consideration:** Integrating collaborative robots requires ethical and legal issues. Questions around employment displacement, rights for employees, data privacy, and culpability in the event of accidents or errors must be addressed. Adherence to ethical norms and remaining current on legal frameworks are critical for successful implementation.

5.1 Future Trends of COBOT

- **Smart Contract:** Smart contracts, which are self-executing contracts with established rules on the blockchain, have the potential to automate certain parts of COBOT interactions. This may encompass duties like scheduling equipment maintenance, allocating resources, and processing payments.

- **Collaborative Manufacturing:** As cobot technology advances, humans and cobots will collaborate more closely. Future improvements will increase human-cobot interaction and communication, enabling them to collaborate smoothly as integrated teams. This collaborative synergy will result in higher productivity, better problem-solving abilities, and overall performance in manufacturing.

- **Small and Medium-Sized Enterprises:** While cobots have achieved substantial momentum in bigger industrial organizations, a future trend will be the widespread use of cobots within small and medium-sized enterprises (SMEs). Cobots will become more accessible to SMEs as technology advances and costs fall. This expansion will make the benefits of cobot technology more accessible to smaller firms, allowing them to increase productivity, competitiveness, and operating efficiency.

- Recently, a successful form of AI algorithms called LLMs has shown promise in improving cobot-user communication. They enable cobots to have organic

conversations with people. Dobby, a GPT-4-powered conversational service robot, is one example of the amazing advancements in this discipline.[11]

5.2 Market Trends of COBOT

The e-commerce and logistics sectors are driving the expansion of the collaborative robot industry due to their high return on investment when compared to traditional industrial robotics systems [11]. Figure.2 depicts the growth of COBOT in the market.

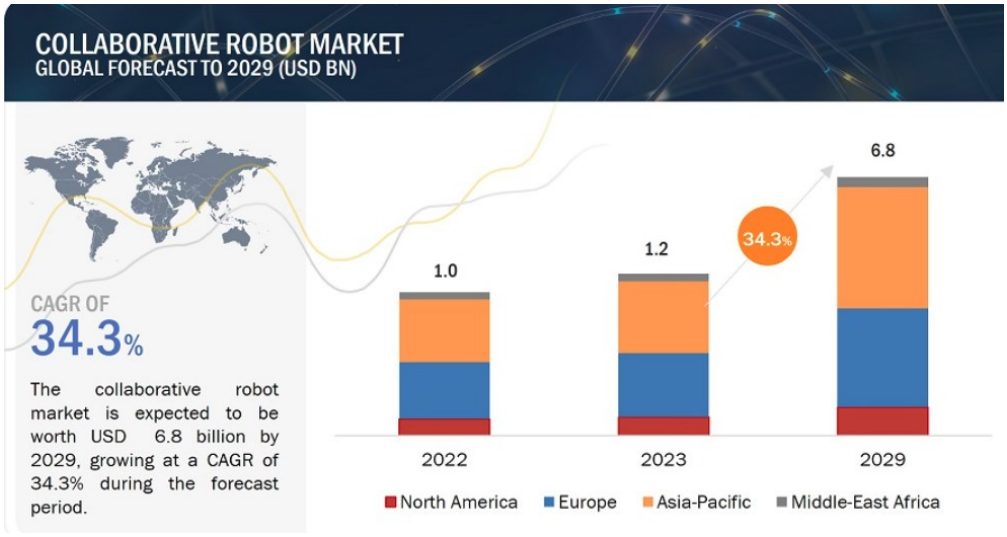

Figure 2. Growth of COBOT in the Market

6. Conclusion

The area of robotics is fast expanding, with many intriguing trends and discoveries to watch. From machine learning and artificial intelligence to soft robotics and swarm robotics, these innovations have the potential to alter a wide range of sectors. As robots progress, we should expect more novel and fascinating uses in the future. The distinctions between the two systems were displayed to emphasize their respective uses and to illustrate which is superior in specific instances, as both the cobot and the robot are capable of doing comparable duties. Cobots were discussed, along with their benefits and drawbacks.

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