

Advancements in Artificial Intelligence for Industrial Robotics and Intelligent Drones: A Comprehensive Review

Dr.A.Shaji George

Independent Researcher, Chennai, Tamil Nadu, India.

Abstract – The way industries run has been transformed by the combination of artificial intelligence (AI) in intelligent drones and industrial robotics. More complicated and efficient robotic systems—which can accomplish difficult tasks with more accuracy and precision—have been made possible by recent developments in artificial intelligence. Covering many facets including collision detection, drone-based surveillance, smart city traffic monitoring, fault detection in robotic arms, and security of industrial robots and drones, this paper offers a detailed analysis of the present situation of AI developments in industrial robotics and intelligent drones. The paper also looks at IoT's and AI/ML's involvement in robotic applications, wireless networks for industrial automation, programming industrial robots and intelligent drones.

Keywords: Artificial Intelligence (AI), Industrial Robotics, Intelligent Drones, Robotics and Automation, Machine Learning (ML), Internet of Things (IoT).

1. INTRODUCTION

The introduction of industrial robotics and intelligent drones has transformed the manufacturing and service industries, changing how companies operate and connect with their consumers.

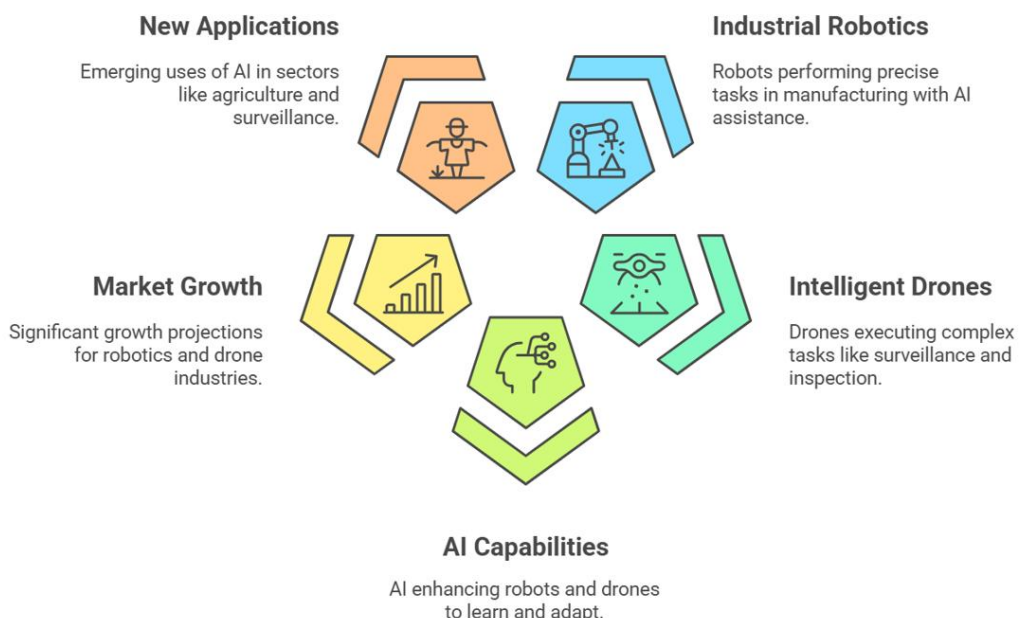


Fig -1: Transformative Impact of AI on Robotics and Drone Industries



Over the last few decades, these technologies have advanced significantly, allowing them to accomplish complicated jobs with more precision, speed, and accuracy. The inclusion of Artificial Intelligence (AI) into industrial robotics and intelligent drones has increased their capabilities, allowing them to learn from experience, adapt to new conditions, and make real-time judgments. The International Federation of Robotics (IFR) reports that the worldwide robotics business has expanded considerably in recent years, with industrial robot sales achieving a peak of 380,000 units in 2020. From 2020 to 2025, the market is anticipated to increase at a CAGR (Compound Annual Growth Rate) of 13.5%, reaching \$135.4 billion by 2025. This growth is anticipated to persist.

Industrial robots that use AI can now perform complex tasks like welding, assembly, and inspection with more accuracy and precision. AI-driven robots can assess data from sensors and cameras to identify product flaws, facilitating real-time quality control and minimizing the likelihood of errors. Furthermore, AI-driven robots has the capability to learn from experience and adjust to novel circumstances, allowing them to execute jobs that were formerly inconceivable. In recent years, there have been substantial improvements in the field of intelligent drones. The global drone market is expected to reach \$43.1 billion by 2025, with a compound annual growth rate (CAGR) of 20.5% from 2020 to 2025. The integration of artificial intelligence (AI) into drones has facilitated the execution of intricate tasks, including surveillance, inspection, and monitoring, with a higher degree of precision and accuracy. For example, infrastructure anomalies can be identified through the analysis of data from sensors and cameras by AI-powered drones, enabling real-time monitoring and inspection.

Also, using AI in factories and smart drones has opened up new possibilities in fields like smart farming, surveillance, and traffic tracking. For example, drones that use AI can be used in farming to improve watering systems, find pests and diseases, and check the health of crops. AI drones can be used for monitoring to spot unusual activities, watch borders, and track suspects. In summary, using AI in robots and smart drones has transformed the way businesses produce and provide services. It helps these robots do tough jobs better, faster, and more accurately. Using AI in these systems has opened up new opportunities in smart farming, surveillance, and traffic tracking. As these technologies improve, we can expect to see more new ways to use them in the future.

2. OBJECTIVE

This article aims to give a clear summary of the latest advancements in AI for industrial robots and smart drones. The article will look at how AI is used in these systems, its advantages, and the difficulties that come with it. The piece looks at how AI, machine learning (ML), and the Internet of Things (IoT) are used in robots and in programming industrial robots and smart drones.

3. METHODOLOGY

This article is based on a comprehensive review of existing literature on AI developments in industrial robotics and intelligent drones. The article draws on various sources, including academic journals, conference papers, and industry reports. The review focuses on the current state of AI applications in industrial robotics and intelligent drones, including collision detection, drone-based surveillance, smart city traffic monitoring, fault detection in robotic arms, and security of industrial robots and drones.

4. COLLISION DETECTION

Collision detection is a critical aspect of industrial robotics, as it enables robots to avoid accidents and ensure safe operation. AI-powered collision detection systems use sensors and machine learning algorithms to detect potential collisions and prevent them. These systems can be integrated with robotic control systems to enable real-time control and decision-making.

4.1 Drone-Based Surveillance

Drone-based surveillance has become increasingly popular in recent years, particularly in industries such as construction, agriculture, and security. AI-powered drones equipped with cameras and sensors can capture high-resolution images and videos, enabling real-time monitoring and inspection. These drones can also be equipped with machine learning algorithms to detect anomalies and alert operators.

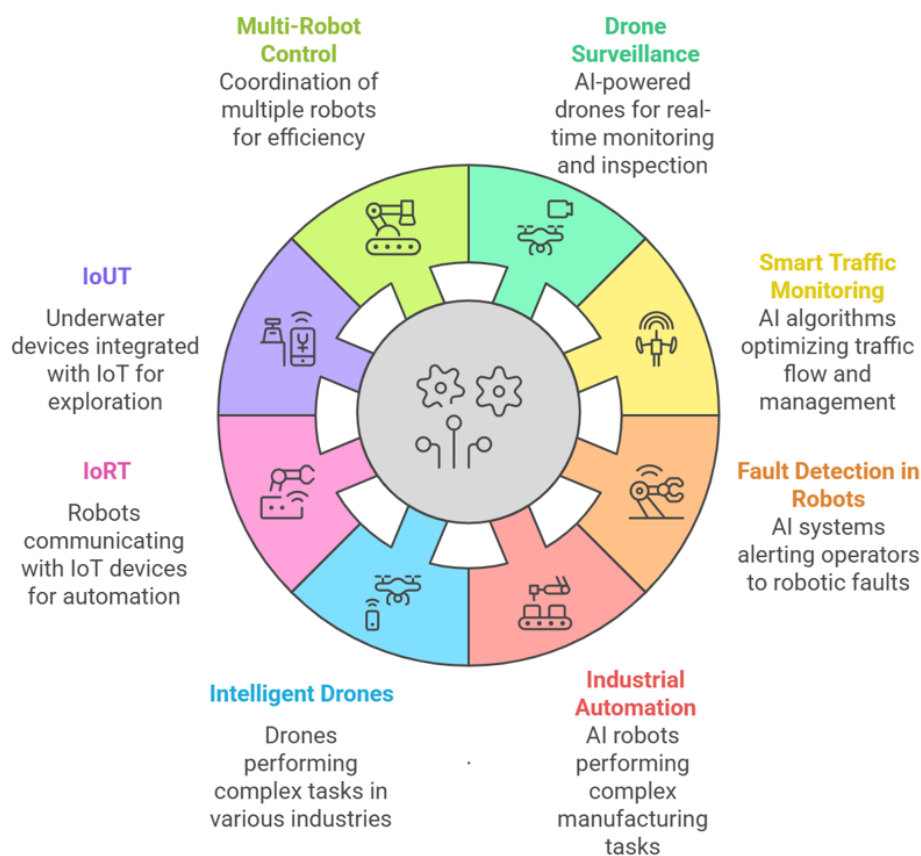


Fig -1: AI and IoT in Robotics

4.2 Smart City Traffic Monitoring

Smart city traffic monitoring is another application of AI-powered drones. These drones can be equipped with cameras and sensors to monitor traffic flow, detect congestion, and optimize traffic light control. AI algorithms can be used to analyze traffic patterns and optimize traffic management, reducing congestion and improving air quality.

4.3 Fault Detection in Robotic Arms

Fault detection in robotic arms is critical to ensure safe and efficient operation. AI-powered fault detection systems use sensors and machine learning algorithms to detect potential faults and



alert operators. These systems can be integrated with robotic control systems to enable real-time control and decision-making.

4.4 Industrial Robots

Industrial robots have been widely adopted in manufacturing industries to improve productivity and efficiency. AI-powered industrial robots can perform complex tasks such as assembly, welding, and inspection. These robots can be equipped with machine learning algorithms to learn from experience and improve performance over time.

4.5 Intelligent Drones

Intelligent drones have become increasingly popular in recent years, particularly in industries such as construction, agriculture, and security. AI-powered drones can perform complex tasks such as surveillance, inspection, and monitoring. These drones can be equipped with machine learning algorithms to detect anomalies and alert operators.

4.6 Internet of Robotic Things (IoRT)

The Internet of Robotic Things (IoRT) refers to the integration of robots with the Internet of Things (IoT). IoRT enables robots to communicate with other devices and systems, enabling real-time control and decision-making. AI-powered IoRT systems can be used in various applications, including industrial automation, smart homes, and healthcare.

4.7 Internet of Underwater Things

The Internet of Underwater Things (IoUT) refers to the integration of underwater devices and systems with the Internet of Things (IoT). IoUT enables underwater devices to communicate with other devices and systems, enabling real-time control and decision-making. AI-powered IoUT systems can be used in various applications, including oceanography, marine biology, and offshore oil and gas exploration.

4.8 Multi-Robot Control

Multi-robot control refers to the control and coordination of multiple robots to perform complex tasks. AI-powered multi-robot control systems use machine learning algorithms to enable real-time control and decision-making. These systems can be used in various applications, including industrial automation, smart homes, and healthcare.

4.9 Programming of Industrial Robots and Intelligent Drones

The programming of industrial robots and intelligent drones is a critical aspect of their operation. AI-powered programming systems use machine learning algorithms to enable real-time control and decision-making. These systems can be used to program robots and drones to perform complex tasks such as assembly, welding, and inspection.

4.10 Robotic Control Systems

Robotic control systems refer to the systems used to control and coordinate robots. AI-powered robotic control systems use machine learning algorithms to enable real-time control and decision-making. These systems can be used in various applications, including industrial automation, smart homes, and healthcare.



4.11 Security of Industrial Robots and Drones

The security of industrial robots and drones is a critical aspect of their operation. AI-powered security systems use machine learning algorithms to detect potential threats and alert operators. These systems can be used to prevent cyber-attacks and ensure safe operation.

4.12 Sensors for Robots

Sensors for robots refer to the devices used to detect and measure various parameters such as temperature, pressure, and vibration. AI-powered sensor systems use machine learning algorithms to enable real-time control and decision-making. These systems can be used in various applications, including industrial automation, smart homes, and healthcare.

4.13 Smart Agriculture Using Intelligent Drones

The utilization of intelligent drones in smart agriculture has gained significant popularity in recent years. Drones powered by artificial intelligence, outfitted with cameras and sensors, may acquire high-resolution photos and videos, facilitating real-time monitoring and inspection. These drones can be outfitted with machine learning algorithms to identify irregularities and notify operators.

4.14 The Roles of AI/ML and IoT in Robotic Applications

AI/ML and IoT play critical roles in robotic applications, enabling real-time control and decision-making. AI-powered robotic systems can learn from experience and improve performance over time. IoT enables robots to communicate with other devices and systems, enabling real-time control and decision-making.

4.15 Wireless Networks for Industrial Automation–Factory Automation

Wireless networks for industrial automation–factory automation refer to the use of wireless communication systems to enable real-time control and decision-making in industrial automation. AI-powered wireless networks use machine learning algorithms to optimize network performance and ensure reliable communication.

5. DISCUSSION

Businesses now operate differently because to the integration of AI into intelligent drones and industrial robotics. Businesses may boost productivity and efficiency by using AI-powered robots to complete complex tasks with greater accuracy and precision. The use of AI in industrial robotics and intelligent drones has also created new prospects for applications in a variety of fields, such as smart agriculture, surveillance, and traffic monitoring. However, integrating AI into industrial robotics and intelligent drones presents a number of issues, including security, safety, and reliability. AI-powered robotic systems require strong security mechanisms to prevent cyber-attacks and assure safe operation. Furthermore, the employment of AI in industrial robotics and intelligent drones necessitates careful consideration of safety and reliability, as these systems have substantial effects on human life and the environment.

6. CONCLUSION

Industrial robotics and intelligent drones, which use AI, have revolutionized the way industries operate. Robots driven by artificial intelligence can do complex jobs with more precision and accuracy, which helps businesses save time and money. However, incorporating AI into industrial robotics and intelligent drones presents various hurdles, including security, safety, and reliability. Additional research is required to overcome these issues and assure the safe and dependable operation of AI-powered robotic systems.



7. RECOMMENDATIONS

Based on the findings of this article, the following recommendations are made:

Further research on AI-powered robotic systems: Further research is needed to develop more sophisticated and efficient AI-powered robotic systems.

Development of robust security systems: Robust security systems are needed to prevent cyber-attacks and ensure safe operation of AI-powered robotic systems.

Careful consideration of safety and reliability: The use of AI in industrial robotics and intelligent drones requires careful consideration of safety and reliability, as these systems can have significant impacts on human life and the environment.

Development of standards and regulations: Standards and regulations are needed to ensure the safe and reliable operation of AI-powered robotic systems.

Investment in education and training: Investment in education and training is needed to develop the skills and knowledge required to design, develop, and operate AI-powered robotic systems.

8. LIMITATIONS

This article has several limitations, including:

Limited scope: The article focuses on the current state of AI developments in industrial robotics and intelligent drones, and does not provide a comprehensive review of all aspects of AI in robotics.

Limited data: The article is based on a limited dataset, and further research is needed to confirm the findings and recommendations.

9. FUTURE WORK

Future work should focus on addressing the limitations of this article, including:

Comprehensive review of AI in robotics: A comprehensive review of all aspects of AI in robotics is needed to provide a more complete understanding of the benefits and challenges of AI in robotics.

Further research on AI-powered robotic systems: Further research is needed to develop more sophisticated and efficient AI-powered robotic systems.

Development of robust security systems: Robust security systems are needed to prevent cyber-attacks and ensure safe operation of AI-powered robotic systems.

Careful consideration of safety and reliability: The use of AI in industrial robotics and intelligent drones requires careful consideration of safety and reliability, as these systems can have significant impacts on human life and the environment.

REFERENCES

- [1] Agrawal, B. P., Sahoo, B., Harini, V., Lavanya, J. A., Jindal, V., Namdeo, A. K., & George, A. S. (2024). AI-Driven robotics for Real-Time manufacturing processes. In *Advances in computational intelligence and robotics book series* (pp. 199–212). <https://doi.org/10.4018/979-8-3693-7367-5.ch014>



- [2] AI developments for industrial robotics and intelligent drones. (2024). In *Advances in computational intelligence and robotics book series*. <https://doi.org/10.4018/979-8-3693-2707-4>
- [3] George, D. (2024a). *Democratizing Compute Power: The Rise of Computation as a Commodity and its Impacts*. Zenodo. <https://doi.org/10.5281/zenodo.11654354>
- [4] Appinventiv. (2024, July 8). *The intersection of IoT and robotics: transforming industries and workforce*. Appinventiv. <https://appinventiv.com/blog/iot-in-robotics/>
- [5] George, D. (2024b). *Digital hoarding: the rising environmental and personal costs of information overload*. Zenodo. <https://doi.org/10.5281/zenodo.12802575>
- [6] Doss, A. S. A., Jeyabalan, A., Borah, P. R., Lingampally, P. K., & Schilberg, I. D. (2023). *Advancements in Agricultural Automation: A Comprehensive review of artificial intelligence and humanoid robotics in farming*. *International Journal of Humanoid Robotics*, 21(04). <https://doi.org/10.1142/s0219843623500123>
- [7] George, D. (2024c). *Gig Economy 2.0: Examining how smart technologies could revolutionize On-Demand work*. Zenodo. <https://doi.org/10.5281/zenodo.13334926>
- [8] *Drone Monitoring Traffic and Crowds: Drones for Effectiveness*. (2024, September 24). Elistair | Tethered Drone Company. <https://elistair.com/monitoring-traffic-drone/>
- [9] George, D. (2024e). *Robo-Revolution: Exploring the rise of automated financial advising systems and their impacts on management practices*. Zenodo. <https://doi.org/10.5281/zenodo.14059485>
- [10] Gabsi, A. E. H. (2024). *Integrating artificial intelligence in industry 4.0: insights, challenges, and future prospects—a literature review*. *Annals of Operations Research*. <https://doi.org/10.1007/s10479-024-06012-6>
- [11] George, D. (2024d). *Reimagining India's engineering education for an AI-Driven future*. Zenodo. <https://doi.org/10.5281/zenodo.13815252>
- [12] *Human factors in robots, drones and unmanned systems*. (n.d.). <https://openaccess.cms-conferences.org/publications/book/978-1-958651-33-9>
- [13] *IEEE Xplore Full-Text PDF*: (n.d.). <https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=10614599>
- [14] George, D., & George, A. (2024). *Towards a Super Smart Society 5.0: Opportunities and Challenges of Integrating Emerging Technologies for Social Innovation*. Zenodo. <https://doi.org/10.5281/zenodo.11522048>
- [15] John, J. (2023, August 31). *Advancements in Robotic Systems: A Comprehensive review of emerging technologies and applications*. <https://www.interestjournals.org/articles/advancements-in-robotic-systems-a-comprehensive-review-of-emerging-technologies-and-applications-101058.html>
- [16] George, D., Baskar, D., & Srikanth, P. B. (2024). *The erosion of cognitive skills in the technological age: How reliance on technology impacts critical thinking, Problem-Solving, and creativity*. Zenodo. <https://doi.org/10.5281/zenodo.11671150>
- [17] Johnson, A., Johnson, A., & Johnson, A. (2024, December 30). *AI-Powered Robots: a new era in automation and efficiency*. *TechResearchs - the Future of Marketing Technology Research*. <https://techresearchs.com/artificial-intelligence/ai-powered-robots-a-new-era-in-automation-and-efficiency/>
- [18] George, D. (2024f). *Automated Futures: Examining the promise and peril of AI on jobs, productivity, and Work-Life balance*. Zenodo. <https://doi.org/10.5281/zenodo.14544519>
- [19] Karunathilake, E. M. B. M., Le, A. T., Heo, S., Chung, Y. S., & Mansoor, S. (2023). *The Path to Smart Farming: Innovations and Opportunities in Precision Agriculture*. *Agriculture*, 13(8), 1593. <https://doi.org/10.3390/agriculture13081593>
- [20] George, D., & Baskar, D. (2024). *Leveraging big data and sentiment analysis for actionable insights: A review of data mining approaches for social media*. Zenodo. <https://doi.org/10.5281/zenodo.13623777>
- [21] Kotyal, K., Nautiyal, P., Singh, M., Semwal, A., Rai, D., Papnai, G., Nautiyal, C. T., GMalathi, N., & Krishnaveni, S. (2024). *Advancements and Challenges in Artificial Intelligence Applications: A Comprehensive review*. *Journal of Scientific Research and Reports*, 30(10), 375–385. <https://doi.org/10.9734/jsrr/2024/v30i102465>
- [22] George, D. (2025). *Workforce Impacts by 2030: Job Losses and Opportunities in an Era of Automation and AI*. Zenodo. <https://doi.org/10.5281/zenodo.14677191>
- [23] *Learn how artificial intelligence (AI) is changing robotics – Intel*. (n.d.). Intel. <https://www.intel.com/content/www/us/en/learn/artificial-intelligence-robotics.html>
- [24] Mahajan, A. (2024). *Artificial Intelligence in Robotics and its Advancements, Challenges and Ethical Considerations: A Review*. *IJERT*. <https://doi.org/10.17577/IJERTCONV12IS03001>
- [25] Mohamed, N. (2023). *Current trends in AI and ML for cybersecurity: A state-of-the-art survey*. *Cogent Engineering*, 10(2). <https://doi.org/10.1080/23311916.2023.2272358>



- [26] Munasinghe, I., Perera, A., & Deo, R. C. (2024). A Comprehensive review of UAV-UGV Collaboration: Advancements and challenges. *Journal of Sensor and Actuator Networks*, 13(6), 81. <https://doi.org/10.3390/jsan13060081>
- [27] Pal, O. K., Shovon, M. S. H., Mridha, M. F., & Shin, J. (2023a). A comprehensive review of AI-enabled unmanned aerial vehicle: Trends, vision, and challenges. *arXiv (Cornell University)*. <https://doi.org/10.48550/arxiv.2310.16360>
- [28] PR Newswire. (2024, June 11). Market leaders: Top high CAGR industries forecasted for the next five years. *Yahoo Finance*. https://finance.yahoo.com/news/market-leaders-top-high-cagr-093200614.html?fr=sycsrp_catchall&guccounter=1
- [29] Publications Office of the European Union. (2022). Investing in our future: quality investment in education and training. Publications Office of the EU. <https://op.europa.eu/en/publication-detail/-/publication/f1309d68-4f56-11ed-92ed-01aa75ed71a1/language-en>
- [30] Rahaman, M., Putra, K. T., Irawan, B., & Biyanto, T. R. (2024). Industrial Evolution. In *Advances in computational intelligence and robotics book series* (pp. 85–114). <https://doi.org/10.4018/979-8-3693-2707-4.ch005>
- [31] Renner, L. (2024, November 5). Artificial Intelligence (AI) and Robotics. *CYNGN*. <https://www.cyngn.com/blog/artificial-intelligence-ai-and-robotics>
- [32] Robotics. (n.d.). https://www.mdpi.com/journal/robotics/special_issues/Industrial_Robot
- [33] Soori, M., Arezoo, B., & Dastres, R. (2023). Artificial intelligence, machine learning and deep learning in advanced robotics, a review. *Cognitive Robotics*, 3, 54–70. <https://doi.org/10.1016/j.cogr.2023.04.001>
- [34] Staff, R. R. (2024, September 24). IFR World Robotics report says 4M robots are operating in factories globally - The Robot Report. *The Robot Report*. <https://www.therobotreport.com/ifr-4-million-robots-operating-globally-world-robotics-report/>
- [35] TechNexion. (2025, January 10). Applications and Advancements of AI in robotics - TechNexion. <https://www.technexion.com/resources/applications-and-advancements-of-ai-in-robotics/>
- [36] visionplatform.ai. (2024a, January 27). AI and Drones: Advancements and Applications in Unmanned Aerial Vehicles. *Visionplatform*. <https://visionplatform.ai/artificial-intelligence-drones/>