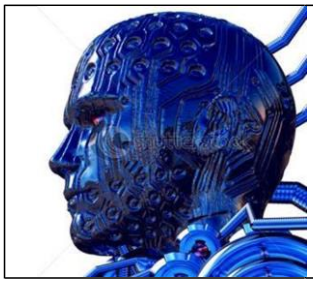

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A BRIEF DISCUSSION ON CURRENT ISSUES IN AI ROBOTICS

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Abstract

Modern AI robotics faces many technical, ethical, and legal problems. Solving these is key to putting autonomous systems into society well. One main engineering problem is making robots dexterous. This needs complex, real-time control of their moving parts and lots of different sensors to copy how humans feel and move in unknown places. As these systems become more independent, questions about who is responsible come up. This is especially true when machines work with little human checking and their choices can affect human safety. Also, current laws often can't keep up with new technology, leaving big gaps in rules about data privacy, unfair algorithms, and how losing jobs to machines impacts society and the economy. This paper argues that, to deal with these problems, we need further research that combines new technology with good ethical rules and smart policy actions in order to make sure robots are used safely and fairly in the future.

Keywords: AI robotics, robot dexterity, responsibility, legal rules.

1. Introduction

This paper proposes a discussion of AI robotics by looking at three main perspectives: how to build them (the technical side), how they should act (ethics), and how to control them (the law):

- How to build (the technical side): this means we need new engineering ideas to fix problems like robot dexterity, coordinating moving parts in real-time, and sensing in many ways. It involves putting together hardware and algorithms that let robots move and work in places we can’t predict;
- How to act (ethics): this looks at the moral issues when independent systems make choices that affect people's lives. The issue is asking what systems should or shouldn’t

do, covering things like privacy, data safety, and making algorithms fair to stop unfairness;

- How to control (the law): This is about making laws and firm rules that ensure things are clear and safe. This part deals with how hard it is to decide who is responsible for mistakes or accidents, especially when machines work with very little human watching.

Overall, the paper suggests that for robotics to work, we need an approach that brings together new technology with good ethical rules and smart legal planning.

2. AI robotics challenges

AI robotics problems include many technical, ethical, and legal issues. These greatly impact how robotic systems are made and used in many areas. As robot technology gets better, there's a bigger need for improved dexterity, reliable real-time control, and sensing in many ways. This is true for things like healthcare and manufacturing, and also for military uses of independent systems like drones. These problems don't just need new engineering ideas; they also need different fields like computer science, mechanical engineering, and neuroscience to work together. This helps deal with the complex ways robots work and how they adapt to different places [1][2].

A big worry in AI robotics is the need for good planning and ways to adapt. This is key to cutting down on failures. As robots are used more often for hard jobs—from operations to space missions—their ability to move and work in unexpected places becomes very important [1].

Also, putting independent systems into use quickly brings up urgent legal and ethical questions about who is responsible. This is especially true when these machines work with little human checking. Current laws struggle to keep up with fast technology changes, showing big gaps in safety rules and policies. These gaps relate to things like jobs being lost and unfairness in AI systems [2][3].

Ethical concerns are (or should be) central when talking about AI and robotics. This is true for privacy, data safety, and the chance of unfair algorithms. As independent systems make big

choices that can affect people's lives, the ethical parts of these technologies have gotten more attention. These now includes not just needing strong data security, but also making AI fair. This is important for people to trust AI and for fair results for everyone [4][5]. Not dealing with these issues could make people less likely to accept AI robotics.

We can say that the current problems in AI robotics need a broad approach. This approach combines new technology with ethical rules and looking ahead in terms of regulation. As society uses these systems more, solving these problems is crucial to getting the most out of robotics while making sure they are safe, accountable, and fair when used [2][4].

3. Overview of current challenges

Robot dexterity and putting smart automatic systems to work bring big problems. We must fix these to make robot technology better. One of the main barriers is effectively coordinating many moving parts in real time, especially with different weights or when parts of the system break. These issues call for more research into materials, structures, and algorithms that make robot systems flexible and strong [1].

So, we can look at these key areas for conducting further research:

- Sensing and control: to get robot hands as skillful as human hands, an ideal robot system must have many types of sensors. These sensors need to copy human touch sensitivity. This means not only being able to sense the environment but also constantly adjusting movement skills in complex, uncertain situations. Because sensing, control, learning, planning, and movement are all connected, progress in one area can greatly help others [1];
- Planning and adaptation: we need strong planning abilities in complex spaces to reduce failures in robot tasks. To do this, we need new ideas that let robots move and work well in many places, from operations to help at home, and even exploring other planets. The difficulty of these tasks makes it even more important for experts in

mechanical engineering, computer science, neuroscience, and how humans and robots interact, to work together [1];

- Responsibility and safety concerns: putting independent robot systems to use brings up urgent questions about who is responsible. With truly automatic systems that can work without human watching, figuring out who is to blame for accidents or wrong use becomes a big legal problem. Current laws struggle to keep up with how fast robotics is changing, especially with very independent systems and their ability to keep learning [2];
- Policy gaps and risks: existing policy rules often aren't ready to handle the safety risks of very independent systems. There are big gaps in dealing with physical dangers, economic effects like people losing jobs, and social issues like unfairness in embodied artificial intelligence (EAI) systems. We urgently need specific policy actions to make EAI safer and to create clearer rules about responsibility. This will help reduce risks with robot technologies [2]. Studying these problems is crucial for robotics to grow. We need solutions based on real world tests and group research to push what robots can do in society.

4. Technical problems for AI robotics

The quick growth of robotics and automation in manufacturing has created many technical problems. Companies need to handle these to make sure things work well. These problems can greatly affect how efficient, safe, and dynamic the workforce is in industrial settings. Some important ones are:

- Cost of putting things together: one of the biggest technical problems in robotics and automation is managing the costs of putting systems in place. Companies need to make sure industrial automation systems are set up efficiently and well, causing as little downtime as possible. Tools like manufacturing simulation, robot simulation software, and digital twins are key to doing this. By letting makers try out the best ways to put

things together, these tools can spot possible problems before they happen. This allows for virtual testing that shows integration issues early on [3][6];

- Shortage of skilled workers: as the need for advanced technologies like AI and robot simulation software grows, the need for skilled workers who can use these tools becomes central. Makers face a skills gap because old education systems often don't teach workers what they need for these high-tech jobs. As a result, companies might need to spend money on their own training programs or work with outside experts to close this gap and deal with the complex parts of putting new technologies into existing systems [3];
- Security worries: making manufacturing processes digital brings big security weaknesses. With more connections, companies must protect their data from possible hacks, as losing data can have serious results, harming both how well things work and people's trust. As manufacturing relies more on cloud computing, security measures must change to handle the special risks of this technology. We need dedicated Operational Technology (OT) networks. However, the lack of skilled cybersecurity people might limit how smoothly companies can put these protections in place [3][6];
- How humans and robots interact and trust: another big technical problem is how humans and robots work together, especially with AI systems that learn and change over time. While robots that follow clear rules are usually accepted, bringing in independent systems raises worries about people losing jobs and worker safety. Setting up a system where humans are involved in the loop can help calm these fears. This makes sure humans oversee important choices, keeping a balance between automation and human checking [4][6];
- Data management and putting data together: companies face the huge job of handling vast amounts of data from sensors, machines, and manufacturing processes. Good data management is critical for using the full potential of digital twins. These need very accurate models and real-time data integration to work well. To use this data, makers must build strong data systems and integration solutions. These solutions need to

handle many different data sources while making sure data is safe and follows data protection rules [4][6].

Also, ethical problems in artificial intelligence (AI) and robotics are becoming more obvious as technology keeps getting better. Ethics, roughly described as studying what people see as right and wrong, looks at what people should or shouldn't do. This is especially true when new technologies create new situations for action [7]. Putting AI into many areas, like healthcare and environmental care, requires a careful look at the ethical issues. The choices made today will shape how society acts and what it values in the future [4] – not just because it's right but for following rules, legal needs, and even for public acceptance.

One of the main ethical concerns is privacy and data safety. With more digital technologies, collecting, storing, and using personal data has created big privacy issues. Companies must use strong data safety measures to protect people's information, as breaking these rules can lead to loss of trust and legal problems [4]. The ethical need to keep data private becomes even harder in areas like healthcare, where sensitive information must be handled with extreme care [8].

5. Future plans, and how AI-driven job displacement affects society

As technology in artificial intelligence and robotics keeps advancing fast, we urgently need a shared way to regulate it. Creating complete standards that encourage clear, ethical design and responsibility in robot systems is essential to lower the risks of using them. However, these standards must come with firm rules to make sure they are put into practice and followed well [2][9]. Ongoing conversations among all involved, including lawmakers, technical experts, and people who study ethics, are key to shaping a regulatory environment that properly handles the problems that modern robotics brings.

Recent studies have also looked at how AI taking over jobs affects society. Researchers like Julian Jacobs argue that old-fashioned retraining programs might not be enough to deal with the economic changes AI brings. This calls for new solutions, including talks about a universal basic income and other economic systems to help workers who lose their jobs [2].

These discussions show how urgently we need a broad approach to the problems AI brings to the workforce. We have seen many problems that are both complex and have ethical issues. These come from the changing world of AI and robotics. This highlights how important it is for different fields to work together and for quick, smart governance. Given how fast technology is changing, now is the time for quick governance and ongoing teamwork among technical experts, ethicists, and lawmakers. We must move towards putting firm rules and ethical design standards in place. These will guarantee clarity and responsibility, making sure that choices made today create a future where robotics helps society in a safe, fair, and equal way.

References

[1] Singh, A. (2025, November 5). 5 key challenges limiting robotic dexterity. AZoRobotics. [online] available at https://www.azorobotics.com/Article.aspx?ArticleID=783, retrieved in [26/12/2025].

[2] Perlo, J., Robey, A., Barez, F., Floridi, L., & Mökander, J. (2025). Embodied AI: Emerging risks and opportunities for policy action. arXiv. https://doi.org/10.48550/arXiv.2509.00117

[3] Visual Components. (2023, February 23). Automation and robotics trends in 2023. [online] available at https://www.visualcomponents.com/blog/automation-and-robotics-trends-in-2023/, retrieved in [27/12/2025].

[4] Deloitte. (2025, December 10). AI goes physical: Navigating the convergence of AI and robotics. [online] available at https://www.deloitte.com/us/en/insights/topics/technology-management/tech-trends/2026/physical-ai-humanoid-robots.html, retrieved in [26/12/2025].

[5] Rapid Innovation. (2024, October 21). Integrating AI agents with robotic hardware: Challenges and solutions. [online] available at https://www.rapidinnovation.io/post/integrating-ai-agents-with-robotic-hardware-challenges-and-solutions, retrieved in [26/12/2025].

[6] Blanchard, A. (2024, April 25). The road less travelled: Ethics in the international regulatory debate on autonomous weapon systems. Humanitarian Law & Policy Blog. [online] available at https://blogs.icrc.org/law-and-policy/2024/04/25/the-road-less-travelled-ethics-in-the-international-regulatory-debate-on-autonomous-weapon-systems/, retrieved in [28/12/2025].

[7] Chen, Y., Clayton, E. W., Novak, L. L., Anders, S., & Malin, B. (2023). Human-centered design to address biases in artificial intelligence. Journal of Medical Internet Research, 25, Article e43251. https://doi.org/10.2196/43251

[8] University of Kansas, Center for Teaching Excellence. (n.d.). Addressing bias in AI. [online] available at https://cte.ku.edu/addressing-bias-ai, retrieved in [26/12/2025].

[9] Wheeler, T. (2023, June 15). The three challenges of AI regulation. Brookings. [online] available at https://www.brookings.edu/articles/the-three-challenges-of-ai-regulation/, retrieved in [27/12/2025].