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Robotics and AI for social justice: new perspectives between assistance, education and ethical reflection

Abstract
Artificial intelligence and robotics are changing the way we approach societal challenges, offering new opportunities to improve inclusion, access to care and ethical reflection. Although concepts such as introspection, consciousness and ethical reflection are the subject of wide philosophical debate, the aim of this paper is not to discuss them theoretically, but to explore how some of their dimensions can be captured in simplified computational models, with practical applications in the context of AI and robotics. This article explores the potential of these technologies to promote social justice. Two main application areas are analyzed: assisting vulnerable individuals, such as the elderly and people with disabilities, and the ability of robots to promote awareness and change in educational contexts. Experiments in the healthcare and school sectors will be used to demonstrate how technology can be used to optimize services and to stimulate critical reflection on the dynamics of exclusion and acceptance. However, the potential of AI and robotics comes with significant ethical challenges, such as the risk of bias and new forms of surveillance. The work emphasizes the importance of a responsible approach to technological development so that innovation can be guided by principles of justice and inclusion rather than purely economic or efficiency logics.
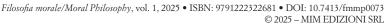
Keywords
Human-robot interaction; Assistive Robotics; Social Justice; Healthcare.

Introduction

In today's context, the definition of vulnerability has taken on increasingly complex nuances that go beyond the simple condition of economic or physical vulnerability. Being vulnerable today means being disadvantaged in terms of access to important resources – education, health, job opportunities – but also in terms of the ability to assert one's rights in a society where inequalities are reinforced rather than reduced.

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People with disabilities, older people, migrants, people with mental disorders or people in disadvantaged economic circumstances are just some of the categories at risk of being excluded from social and decision-making processes. But vulnerability is not just an individual condition: it is often the product of a system that, despite consolidated welfare mechanisms, is not always able to guarantee equal opportunities for all.

This reality concerns society's perception of diversity and the way in which it is welcomed or rejected is not merely a question of access to resources. We had the opportunity to explore this aspect in a project with a middle school class in which we used a robot to initiate a reflection on the meaning of diversity. It was surprising to observe how the students began to see 'difference' not as a threat but as a resource, as an opportunity for the growth of the whole group. The robot itself, which was initially seen as a foreign element, became the catalyst for a change of perspective: what if diversity was not an obstacle, but an opportunity for enrichment?

At a time when technological progress has become the main driver of social change, one of the key questions is: can technology be a means of reducing these inequalities, or does it run the risk of exacerbating them?

So far, artificial intelligence and robotics[1,2] have been developed primarily with the aim of increasing efficiency, shortening working hours and simplifying production processes. However, their potential goes far beyond this: if used consciously and responsibly, they can become important tools to improve well-being and promote the inclusion of those population groups that are more at risk of being marginalized than others.

The use of AI to support healthcare decisions[3,4], the use of robotics to improve the care of the elderly[5,6] or patients with special needs[7], the development of intelligent education systems that can adapt to the different

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[7] G.A. Papakostas, G.K. Sidiropoulos, C.I. Papadopoulou, E. Vrochidou, V.G. Kaburlasos, M.T. Papadopoulou, V. Holeva, V.A. Nikopoulou, N. Dalivigkas, *Social robots in special education: A systematic review, "*Electronics", 10 (12), 2021, p.1398.

needs of students[8]: all these scenarios show how technology can be a real breakthrough in dealing with vulnerability. However, the question is not just a technical one, but a deeply ethical one: how can we design and use these tools in such a way that they truly contribute to social justice and do not become an additional tool of discrimination or exclusion?

From this perspective, addressing the issue of vulnerability means recognizing its many forms and primarly understanding how technology – and AI and robotics in particular – can play a crucial role in promoting a more just and inclusive society.

Technologies for equity in access to care and support for the most vulnerable

In recent years, scientific and technological research has paid increasing attention to improving healthcare systems to ensure equitable access to care and adequate support for the constantly aging population[9,10], in terms of efficiency and economic sustainability. The calls for proposals of recent European projects show how central the issue of public health is: from the digitalization of healthcare facilities to telemedicine, from assistive robotics to artificial intelligence used for early diagnosis and personalization of treatments.

One aspect that is often underestimated when it comes to improving healthcare is the well-being of those who administer it: doctors, nurses, social and health workers. A healthcare system that cares for patients is a system that must first and foremost care for those who work in it. Overcrowded hospitals, unsustainable workloads, burnout among healthcare professionals: these factors undermine the quality of care and the ability of a healthcare system to function equitably and inclusively[11]. Technological support could represent a turning point in this sense: the use of AI to automate administrative and bureaucratic tasks, robotics to reduce the physical burden on staff, remote monitoring systems to reduce unnecessary hospital visits.

In addition to the well-being of healthcare professionals, there is also a fact that requires urgent reflection: Our society is aging. According to

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[8] C. Syriopoulou-Delli, E. Gkiolnta, *Robotics and inclusion of students with disabilities in special education,* "Research, Society and Development", 10(9), 2021, pp. 1-11.
[9] W.C. Mann, *The aging population and its needs,* "IEEE Pervasive Computing", 3(2), 2004, pp.12-14.
[10] M.E. Pollack, *Intelligent technology for an aging population: The use of AI to assist elders with cognitive impairment,* "AI magazine", 26(2), 2005, pp. 9-24.
[11] K. Doulougeri, K. Georganta, A. Montgomery, *"Diagnosing" burnout among healthcare professionals: can we find consensus?,* "Cogent Medicine", 3(1), 2016, pp. 1-10.

WHO[12,13] estimates, the number of older people with chronic diseases will increase exponentially in the coming decades, putting unprecedented pressure on healthcare systems. This means more patients to treat and a greater need for long-term care. And this is where technology comes in: advanced home automation solutions, robotic assistants for home monitoring and support, AI for personalized management of treatment plans could help make healthcare more sustainable by enabling people to age in their own environment, reducing avoidable hospital admissions and improving quality of life.

It's not just about surviving longer, it's about aging well. Healthy aging is a key challenge for the future of our society, which is becoming older, lonelier and less cared for. This is health issue and at the same time a social and cultural one. Families are not always able to care for older people, whether for economic reasons, work dynamics or changing lifestyles. Technology can fill some of these gaps and create new spaces for sociality and support: from companion robots that encourage interaction and cognitive maintenance, to digital platforms that connect older people and caregivers, to virtual reality tools that combat isolation.

And the same goes for other vulnerable categories, such as families with autistic children or with learning disabilities. Today, there is much talk of an increase in cases of intellectual disability and autism: perhaps because we finally have the tools to diagnose them, perhaps because society itself has changed, setting rhythms and models that make the need for support clearer.

Whatever the cause, the fact is that more and more families are confronted with parenting and relationship problems for which the traditional system does not always have adequate answers.

And here we come back to the central point: what kind of society are we building? Are we moving towards a more inclusive model that responds to people's needs, or are we just creating new gaps, new forms of exclusion? In the face of these changes, we cannot afford to be passive bystanders. Technological innovation, when guided by the values of equality and inclusion, can become a powerful tool to respond to these new challenges. It is important to emphasize that it is not about replacing human relationships with machines, but about using technology to strengthen the social fabric and create new forms of support, connection and participation.

So the question is not whether technology can help us, but how we want it to do so. What principles should guide us in developing solutions to help? What ethical boundaries should we set? We are facing one of the greatest challenges of our time: we need to rethink our idea of care and community and then to ensure equitable access to health.

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[12] https://www.who.int/health-topics/ageing#tab=tab_1
[13] https://www.who.int/news-room/fact-sheets/detail/ageing-and-health

Technology, rights and inclusion: a bridge to equity

When we talk about equal access to healthcare and a fairer healthcare system, we inevitably have to address the issue of rights. Health is a fundamental right, but we know that it is not always guaranteed for everyone under the same conditions. There are economic, cultural, logistical and even cognitive barriers that prevent many people from getting the care they need. People who suffer from a disability, for example, must have the right to the same care as others and to access methods that take their special needs into account. The same is true for people with autism spectrum disorders, for older people with cognitive difficulties, for those who come from disadvantaged backgrounds or are in a state of social vulnerability.

In this perspective, technology also and above all becomes a means of reflecting on these issues and educating people to make more ethical and responsible choices. This is where artificial intelligence and robotics can come into play, as practical tools and as means that can promote new forms of awareness and integration.

Consider, for example, the interaction between humans and robots. A robot can be programmed to respond impartially, to suggest scenarios that present the interlocutor with ethical dilemmas, and to accompany them in a process of critical reflection on their own choices. Imagine a robot assistant in a hospital or school: it could perform supportive functions and at the same time be designed to guide users along the path of sensitization and awareness of rights and inclusion. A child interacting with a robot could be made to think about the importance of treating all people fairly, a doctor could be helped to navigate complex clinical decisions, a vulnerable person could find in AI a means of making their voice heard.

But how can this idea be translated into something concrete? Which technologies can actually help to create a fairer and more inclusive society? To answer these questions, it is worth examining some experiences where artificial intelligence and robotics have been used in real-life scenarios, both in the health and education sectors.

On the one hand, we have seen how the use of robots and AI in healthcare can provide innovative solutions to support patients and medical staff. On the other hand, we have observed how technology can be used to stimulate ethical reflection, as in the case of the experiment conducted with a school class, where a robot was the starting point for a discussion on diversity, inclusion and acceptance.

In the next sections, we will analyze these two scenarios in more detail and try to understand the potential of the technology used and mainly the challenges and implications of its responsible use.

Artificial intelligence and robotics for ethical and inclusive interaction

When it comes to the application of artificial intelligence and robotics in society, there is a danger that the discussion will be reduced to a question of automation and optimization. But there is a much deeper aspect that research is trying to explore: can the technology help and also stimulate ethical considerations, promote well-being and support social integration and inclusion?

In our research, we focus on two directions that address these questions. On the one hand, we are developing solutions to support healthy aging and the wellbeing of the most vulnerable, such as the elderly and patients with special care needs. On the other hand, we are exploring how artificial intelligence can be equipped with a mechanism of ethical introspection, capable of critically evaluating its own decisions and positively influencing those who interact with it.

Assistive robotics for well-being and healthy aging

The growth of the elderly population and the increasing pressure on healthcare systems require new solutions that can support patients, caregivers and medical staff. One of our research focuses is the development of robotic systems that are capable of interacting with users in a personalized way, adapting to their needs and promoting behaviors that enhance well-being.

An innovative aspect of this research is the integration of Large Language Models (LLMs)[14,15] to make interaction with the robot more natural and accessible. The latest generation of language models makes it possible to improve the understanding of context and the system's ability to respond flexibly and contextually. However, their use is not without its challenges: LLMs can make the robot more autonomous in conversation, but they can also present problems related to the generation of unpredictable responses, the possibility of reinforcing biases, and the difficulty of ensuring absolute reliability of information. A central point of our research is to integrate these tools into a controlled context in which the robot is not limited to generating answers, but can critically evaluate its statements and justify them in a transparent way.

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[14] W.X. Zhao, K. Zhou, J. Li, T. Tang, X. Wang, Y. Hou, Y. Min, B. Zhang, J. Zhang, Z. Dong, Y. Du,. *A survey of large language models, arXiv preprint arXiv:2303.18223* 1, no 2 2023.
[15] A.J., Thirunavukarasu, D.S.J. Ting, K. Elangovan, L. Gutierrez, T.F. Tan, D.S.W.Ting, *Large language models in medicine, "Nature medicine"*, 29(8), 2023, pp.1930-1940.

In addition to the use of language models, we are also exploring the potential of multi-agent systems[16,17], i.e. architectures in which several artificial intelligences work together to achieve common goals. This approach makes it possible to design more dynamic and adaptable environments in which the assistant robot does not act as an isolated entity but interacts with other agents, e.g. telemedicine platforms, environmental sensors and decision support systems for doctors and nursing staff. The use of multi-agent systems opens up interesting perspectives for the management of home care and for the personalization of care and also brings new challenges in terms of coordination, communication and safety between the various components of the system.

An artificial intelligence capable of ethical introspection

If, on the one hand, assistive robotics aims to improve people's well-being through active support, a more theoretical but equally crucial aspect concerns the possibility of endowing machines with a form of ethical introspection.

We wonder whether it is possible to develop an artificial intelligence that is capable of critically evaluating its own decisions and changing its own decisions on the basis of an internal reflection process. Such a system would not only execute predefined rules, but would be able to check, update and even change its range of values depending on the situation.

Integration with advanced language models can also play an important role here. A robot reasoning about its ethical decisions must "think" and be able to communicate its reasoning in a clear and understandable way. LLMs can be used to improve this ability, allowing the robot to express and justify its decisions in a way that is easier for humans to understand. However, the biggest challenge remains controlling the consistency and reliability of the explanations provided by the robot: the ethical reflection of an intelligent system cannot be based on statistically probable answers, but must be guided by structured and verifiable principles.

Another research direction we are investigating is the use of specialized artificial agents within a multi-agent system, in which different AI components work together to make more complex ethical decisions. This approach distributes the computational load and increases the reliability of the system, but also raises questions about the role of coordination be-

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[16] W.Van der Hoek, M. Wooldridge, *Multi-agent systems,* "Foundations of Artificial Intelligence", 3, 2008, pp. 887-928.
[17] A. Dorri, S.S. Kanhere, R. Jurdak, *Multi-agent systems: A survey.* "Ieee Access", 6, 2018, pp.28573-28593.

tween the agents: to what extent can we allow robots to negotiate ethical solutions with each other? In what contexts is it acceptable to delegate some of the ethical considerations to an AI system?

From theory to practice: the value of research

This research is not just a theoretical exercise, but lays the groundwork for real-world applications that could change the way we interact with technology. When it comes to robotics and artificial intelligence, there is a danger of viewing these systems as mere entertainment products or advanced automation tools. However, the reality is very different.

Creating a system that is capable of interacting meaningfully with humans means tackling complex problems of cognitive engineering, computational ethics and artificial intelligence. The key is to design architectures that incorporate psychological models, learning strategies and adaptation mechanisms, rather than simply writing code.

The integration of LLMs and multi-agent systems opens up new perspectives, but also raises profound questions about reliability, control and social implications. A robot that can explain its behavior can contribute to greater transparency and trust, but only if its motivations are truly understandable and verifiable. Similarly, an AI that collaborates with other agents can provide more advanced solutions, but it also introduces new levels of complexity that need to be carefully managed.

The goal of our research is to understand how we can use new technologie to create a fairer and more inclusive society and to develop them. This requires a constant dialog between science, ethics and society so that innovation is guided by technological efficiency and then, above all, by a conscious reflection on its impact.

Technology and reflection on the different: the robot as a catalyst for awareness

When we think about the use of robotics and artificial intelligence in the field of inclusion, the focus is often on their ability to support the daily lives of people with difficulties by providing tools to improve communication, learning or autonomy. However, there is another, less explored but equally important perspective: the ability of these tools to stimulate deeper thinking about the concept of diversity and acceptance.

Based on this idea, we decided to test the impact of a robot in an educational context to find out how its presence could influence the way children perceive "otherness". The starting point was a concrete need: to

make a statement about how robotics can be used to promote the integration of children with autism spectrum disorders within the classroom community. We decided to involve a middle school class in our city and turn the experience into a theater workshop, with the robot as one of the main characters in the scene.

The idea, which developed naturally in discussion with the children, was to tell a story about bullying in which the "other" was the autistic child in the class and the robot itself. In this way, we were able to approach the topic of exclusion from a particular perspective: the robot, as a foreign element, was immediately recognizable as different, but its presence gave greater expression to the perception of diversity within the group itself. In the story the boys wrote, the robot could only make friends with the autistic child and with a classmate who had just arrived from another school, both of whom were perceived as "strangers" by the other members of the class. This parallel has made it clear that the concept of diversity is often arbitrary and based on social patterns rather than actual incompatibilities.

From a technological point of view, the experiment posed no particular challenges: the interaction between the robot and the children took place naturally, without the need for complex interventions. But that is precisely the point: it was not the technology itself that was decisive for the experience, but the meaning that its presence had in this context. The robot wasa catalyst for thought and not merely a tool, an element that could draw attention to issues that would have remained in the background in a normal situation.

What made the experiment particularly interesting was the way in which the students worked out the meaning of diversity. The robot, which is free of prejudice and social patterns, allowed them to look at the problem with a fresh eye. The story they built ended with the bullies realizing at the end of the performance that the most important lesson they ever received was that they changed their minds.

This leads to a wider reflection. We often get so used to the diversity that surrounds us that we no longer notice it: older people, disabled people, people with learning difficulties are part of our world, but their condition no longer inspires active reflection. A foreign element, such as a robot, can instead draw attention to these issues, precisely because it represents a "new other", something that does not fit into our usual patterns. It is paradoxical, but it is as if in order to really think about inclusion, we need yet another Other that can confront us with our own mechanisms of acceptance and rejection.

This experience has shown that the use of technology is not limited to offering practical solutions for integration, but can also be a means to raise awareness and change perceptions of diversity. The robot in

this case was not a simple assistant, but a tool that encouraged ethical reflection, a means by which the children could examine and redefine their prejudices.

This prospect opens up interesting scenarios for the future. If technology can help us to reflect on who we are and how we treat others, then its role goes far beyond simple assistance: it can become a tool that improves our ability to live with diversity, to accept it and, above all, to recognize its value.

Conclusions

The analysis carried out in this thesis has made it clear that artificial intelligence and robotics are not just technical tools, but can play a deeper role in building a fairer and inclusive society. If used consciously, these technologies can help bridge social divides, ensure more equitable access to basic services such as health and education, and promote ethical reflection on the dynamics of exclusion and vulnerability.

The opportunities arising from the integration of technology into the social sphere are manifold. The use of robots and artificial intelligence in the care of the elderly, patients with special needs or students with learning difficulties can be a decisive factor in improving the quality of life and strengthening the rights of those who are often marginalized. In addition, the ability of technology to stimulate ethical reflection through interaction and self-explanation opens up new perspectives and transforms intelligent systems into real catalysts for awareness.

However, these opportunities must be balanced by a careful consideration of the ethical challenges they present. Technology is not neutral: the choices made in its development and implementation can reinforce existing inequalities or create new forms of exclusion. The risk of bias in AI systems, the loss of privacy and the increasing use of algorithmic surveillance are issues that cannot be ignored. Adopting a responsible approach to technological development is therefore crucial to prevent these tools from becoming tools of control rather than emancipation.

Ultimately, the relationship between social justice and new technologies is characterized by a delicate balance between potential and responsibility. AI and robotics can offer exceptional tools to promote greater justice, but only if they are accompanied by constant ethical reflection and a concrete commitment to ensure that their use does not reinforce inequalities, but reduces them.