Case Study

Intellectual Property Rights in Robotics Technology and Industrial Automation: Challenges and Opportunities

AMARESH MUDDEBIHAL

ALLIANCE UNIVERSITY

Case Study

Intellectual Property Rights in Robotics Technology and Industrial Automation: Challenges and Opportunities

Abstract
The exploitation of this technology for robot applications in industrial automation revolutionized many departments, increasing productivity and accuracy while reducing labor cost. More importantly, however, these technologies present a complex problem to IPRs. The current IPR framework has established the platform for safeguarding discoveries but does not face the problems addressed in robotics, including patentability, ownership of autonomous inventions, data ownership, licensing complications, and cross-border technology transfer. This paper critically explores these IPR issues, examines their implications on businesses to use them, and presents new visions of managing the fast-changing IPR landscape. With the advancement of robotics, there is an absolute need for developing and evolving the law of IPR in a new and improved paradigm of innovation and protection of the concerned stakeholders.

1. Introduction

1.1. The Evolution of Robotics and Automation in Industry

The development of robotics and industrial automation is one of the most pivotal technological changes in the 21st century. Essentially, robotics refers to the interdisciplinary branch of engineering and science that involves mechanical engineering, electrical engineering, computer science, and AI, among others. It has nowadays found its application in industries that range from automotive and logistics, healthcare, and electronics to agriculture.

As an area of automation, robotics technology uniquely can replace labor - intensive work, reduce the interoperation error rate, and increase productivity in most other sectors. From the late 20th century, automation in industries moved from simply repeating mechanisms into complex robots powered by artificial intelligence that can perform complex operations with minimal human interference. Among the current popular applications are precision manufacturing in automotive industries, AI-guided surgery in the health sector, and autonomous delivery systems in logistics.

This combined power from robotics, machine learning, and artificial intelligence gave birth to what is now referred to as "Industry 4.0," or the Fourth Industrial Revolution. In its most basic terms, it represents digitization and automation by smart technology in the traditional industrial process. The interconnected nature of these systems through the Internet of Things, or IoT, leads to "smart factories," where machines communicate, analyze, and improve on their functions independently.

This does not change the fact that there are issues, especially in the legal aspect, with the law of intellectual property (IP) failing to catch up with rapid technological changes. Patent

protection and ownership, licensing, among other things, pose very complex issues on top of which is the issue that robotics often involves the input of several disciplines, each governed by its own IPR regulations.

This paper will discuss in detail some of the potential roadblocks that might arise at the intersection of robotics technology and IPR, including issues related to patent protection, ownership of AI-generated creations, data ownership, and licensing models. The paper will also provide actionable recommendations toward legal reforms that may ensure the IPR framework evolves congruently with advancements in robotics technology.

1.2. Importance of IPR in Robotics and Automation

Intellectual property rights, therefore, play an important role in guaranteeing innovation and the protection of inventors' interests so that healthy competition will be allowed in the market place. IPR will ensure that inventors and organizations can enjoy legitimate protection in the monetization of their ideas and prevent the unauthorized copying or use of innovations. Patents, copyrights, trademarks, and trade secrets give businesses and their creators the ability to maintain exclusive control over the use and distribution of their inventions for a limited period, allowing them to recover investment in research and development.

In the field of robotics, R&D can be very high in terms of both software and hardware investment. Therefore, protection under IPR is essential for these areas. Innovation in robotics cuts wide fields like mechanical engineering, artificial intelligence, sensor technology, human interfaces, and data analytics. Such technologies come within the compass of protection offered by the present framework of IPR. There is a growing trend in robotics companies getting patents for their hardware inventions and copyrights on AI and machine learning algorithms for software.

The increases in sophistication and autonomy of robotics systems bring along problems of advantages. AI-powered robots may behave independently with their capabilities to adjust to new environments wherein they are provided and even to produce new inventions or works of creativity. Ownership and rights to such intellectual property raise serious issues of concern. The big data requirement to train the AI system further complicates the protection landscape of trade secrets and ownership rights.

An infallible and holistic IPR framework is the call of the day, especially when robots have started to mechanize a vast number of industries. Unclear IPR guidelines will further deter businesses from investing in robotics research and development: the inevitable result will be the stagnation of technology and creative work. This paper attempts to draw attention to the gaps that exist between IPR protection for robotics and automation technologies and puts forward solutions for revamping the legal system to cope with innovative technology.

---

2. The Role of Robotics in Industrial Automation

2.1. The Emergence of Robotics in Modern Industries

Robotics technology can be described as the bedrock of modern industrial automation. Generally, in its most general use, industrial automation is the application of control systems-

which are computers, robots, and information technology-in managing processes and mechanisms in factories in order to decrease human labor intervention. Historically, robots that were employed in industries offered a safe means of doing recurrent jobs which called for precision and consistency, such as welding and assembling components on an automobile manufacturing line.

For example, robots in the auto industry can weld, paint, and also assemble parts completely without human intervention. In logistics, they have been used for inventory management, sorting, and even autonomous delivery. For instance, Amazon employs thousands of robots in its warehouses to better manage its inventory and speed up deliveries.

In recent times, robotics has transformed the healthcare industry. Surgeons may now conduct highly precise minimally invasive surgery with da Vinci Surgical Systems. Then there are autonomous mobile robots used in hospitals to transport medical supplies. The accuracy and efficiency are further maximized with minimal opportunities for human error to creep in.

At the same time, with increasing industrial developments in the field of robotics, the legal frameworks related to IPR seem to lag. It is particularly true with respect to safeguarding innovation in AI and machine learning, which mark the core of most advanced robotic capabilities.

2.2. Robotics and the Industrial Revolution 4.0

The new wave of industrial automation, considered to be the Fourth Industrial Revolution, is currently known as Industry 4.0. At the core of Industry 4.0 is the concept of smart systems that connect to other machines and even to human operators through the Internet of Things. These systems gather data from sensors, apply machine learning algorithms to analyze the information, and adjust accordingly to optimize their performance and even decision-making. Industry 4.0 is, therefore, a data-driven paradigm that couples robotics and AI in order to automate real-time decision-making. It represents a new frontier of digitization that opens up flexible production, predictive maintenance, and large-scale customization of products on an individual basis.

With the coming of Industry 4.0, many new challenges appear for IPR in that complexity generated by robotics, data analytics, and AI cannot be fully dealt with under the present legal architecture. While physical inventions such as the robotic arm can be patented, questions arise under current laws on algorithms and data driving the commercial robots.

Perhaps one key new challenge that Industry 4.0 must address is safeguarding the algorithms that power smart factories. Unlike traditional machineries, which may be patented as a novel mechanical function, AI algorithms running the Industry 4.0 systems need not be new and therefore lack one of the required foundations for patent protection-they may operate on an existing machine learning model.

Another pressing question is who owns the data being created by robotics systems. Within the smart factory, robots collect real-time data and analyze it to ensure that they operate their processes in the most optimized way and make autonomous decisions. However, it remains unclear who owns this data: the company operating the factory, the algorithms' developers, or

the robot manufacturers. These questions about ownership and usage rights of data become poignant in telling how intellectual property laws should evolve in the context of Industry 4.0.

3. Intellectual Property Rights in Robotics

3.1. Patent Protection for Robotics and AI

Patent law offers inventors protection by granting them exclusive rights to exploit their inventions for a limited period. In the field of robotics, patents typically protect new and useful inventions, including mechanical systems, electronic components, and software algorithms. However, patenting robotics innovations is a complex and often contentious issue due to the interdisciplinary nature of robotics and the integration of AI.

Challenges in Patenting Robotics and AI Innovations

Robotics technology is by definition the combination of hardware and software elements. The former, consisting of a robotic arm or sensors, for instance, can be patented as any other mechanical invention. However, the software-driven components- not to mention those pertaining to AI and machine learning-will pose harder problems regarding patent protection.

As an example, technology ideas on machine learning that permits robots to adapt and learn their environment make up a range of abstract ideas that may fall outside the scope of patentability under US or EU law. It is as challenging as figuring out what is an innovation worthy of patent protection versus an abstract idea or a natural phenomenon.

Further, patentability inventive step questioning is often affected by AI-driven robotics. In case an AI system delivers solutions independently, it becomes challenging to look into the question from a legal point of view: whether the product is novel and nonobvious. It might be hard for the courts of law to decide whether the invention is inventive enough for the purpose of patenting, considering the fact that the AI system is basing its results on existing data and algorithms.

Case Study: Patent Disputes in Robotics

A more recent example of complexity surrounding patenting of robotics is the case of patent controversy between iRobot and other competitors over respective robotic vacuum cleaners' technology. iRobot popularized the Roomba vacuum cleaner, and it currently owns most patents approved for navigation and cleansing capabilities by its robotic devices. The competitors challenged these patents to their grounds that the involved technologies are nonpatentable because they relate to prior inventions and do not meet patentability.

This case highlights the difficulty of determining true innovation and incremental steps in robotics technology. As companies continue penetrating the robotics market, patent dispute cases will only become more appealing, making the litigation even more complicated.

Potential Reforms in Patent Law

Patent offices should modify their rules and standards to become considerate of these unique features of AI-driven systems, maybe by making their criteria for declaring an invention

patented in connection with AI even more specific. Patent offices can also create new patent categories especially for "AI-specific" and accredit the value of machine learning algorithms along with the innovation force on their side.
A multi-tiered patent system would be essential in effectively differentiating mechanical inventions from those driven by software. In some instance, it would classify the protection given to hardware, software, and AI components into different levels to ensure that each element of robotics technology is captured.

3.2. Ownership of Autonomous Creations

One of the biggest issues in robotics and AI is also ownership over creations autonomously generated by machines. In deep learning and neural networks, especially, these AI systems can start churning out quite entirely new inventions, works of art, or designs completely without a human hand directly involved in their creation. Then there are such subtle questions of intellectual property rights:

The Current Legal Framework

Under the existing intellectual property laws, patents and copyrights are exclusively held by human inventors. This would mean that if an AI system invented something or created some form of work, those rights would automatically default to that person or legal entity responsible for the development or even running of the system. However, in this model, it will not be considering cases in which the AI operates with no human oversight and cases in which there are several entities involved in its creation.

For example, if an autonomous system is developed by a robotic company where AI automatically produces a new product, it raises the question of ownership of the patent: will it be the company that developed the AI system, the user of the system who used it for the production of the design, or the AI system itself.

International Perspectives on AI-Generated Works

It varies between jurisdiction and the kind of approach taken to what has been done concerning AI-generated works. In the United States, the U.S. Copyright Office holds that only works by humans can qualify for copyright protection. Similar views have been held in the European Union in interpreting copyright under the context of works generated by AI, which cannot extend to works generated by an AI unless a human author can be identified.

However, some are beginning to unlock the doors of the roads. For example, in the UK Copyright, Designs, and Patents Act (CDPA), "computer-generated works" are considered admissible; that is, works that are generated by a computer, without any human creator. The right of the copyright owner, according to the CDPA, is that person who made appropriate arrangements for the origination of such a work. This method could, perhaps, serve as one of the points of reference for rights allocations in the case of works created with AI, but it still does not resolve the issues associated with autonomous robotics.

The Debate Over Electronic Personhood

The most contested proposals on the issue have been "electronic personhood." Essentially, it is an idea by the European Parliament that advanced AI systems should be granted legal personhood in order to own intellectual property, make contracts, and even be held liable for damages.
While electronic personhood may have reached significant attention, it has been opposed by legal academics and ethicists on the same level. This is because their ideas would detract the basic human rights and legal accountability. This is also an ethical issue in regard to the treatment of AI systems as autonomous agents who deserve rights equal to human beings.

3.3. Licensing and Technology Transfer in Robotics

Licensing agreements are an indispensable part of commercializing robotics technology. Those licenses help to reveal innovations for inventors and businesses but yet retain control over how intellectual property is utilized. Licensing in robotics is often much more complex than other disciplines due to the interdisciplinary nature of robotics and where hardware, software, and data analytics blur and mesh together.

The Role of Universities in Technology Transfer

Among the research and development breakthroughs were born many of those that led to robotics-technology advancements. Universities play an important role for the further development of the field of robotics, most notably, through the research and development process in collaboration with industry, resulting in new products with a transfer of technology into saleable items. However, the process of technology transfer-licensing academic innovations to private companies for marketing-is quite different.

Probably, ownership of intellectual property is the most challenging issue in collaborating between universities and industries. Although the patents are owned by the university on the underlying technology, it is the industry partner who transforms this technology into a commercial product. The negotiations regarding some licensing arrangements like royalties, usage rights, and shared future innovations can become cumbersome.

It is unlikely that academic researchers will be enthusiastic about technology transfer if they feel that their work will be compromised by commercial interests. Academic openness to open-source licensing models, which open the field to greater collaboration and sharing of innovation, have become popular. However, while open-source licensing may not avow one the same protections as traditional patents, there are nonetheless serious concerns about the commercialization of open-source robotics technologies.

Cross-Border Licensing Agreements

Examples of this international expansion of companies in the robotics industry in recent times include cross-border licensing agreements, which have created a sophisticated situation because other nations generally do not have the same IPR laws as those countries within the United States. For example, if one patents an idea within the United States that is valid but is not recognized in any other jurisdictions or if one files patent applications separately in separate countries where a company intends to operate.

They will also have to cope with and learn multiple trade secret laws across jurisdictions, which oftentimes are dramatically different. Countries have differing laws with respect to civil law or criminal penalties for those disclosing or stealing trade secrets. Licensing agreements that cross borders have to accommodate such differences in protecting intellectual property across markets.

Licensing Models for Software-Driven Robotics

In view of this, as systems involving robotics become increasingly software- and AI-reliant, the licensing models already deployed in traditional contexts of innovation may have to be adapted to reflect the specific characteristics of software-driven innovations, such as what has come to be known as "dual licensing," where a firm offers both an open-source version of its software for free to non-commercial users but sells it under a commercial license.
While dual licensing successfully demonstrated its impact in the software world and has been leveraged well in AI and machine learning platforms, it is relatively new for robotics. As a result, companies would need to make decisions about colliding trade-offs that exist between cooperation and the protection of intellectual property.

3.4. Data Ownership in AI-Driven Robotics

Perhaps the biggest issue about this age of AI-directed robotics is ownership over data. Contemporary robots, especially in industrial automation, heavily rely on enormous amounts of data to function effectively. Data is collected through perceptions, apprehended by sensors and cameras, fed through algorithms of machine learning, and subsequently used to customize performances in real-time.

The Value of Data in Robotics

Data is now oftener referred to as the "new oil" of the digital economy and has become a valuable asset in the robotics world- especially for robots operating in industrial environments like factories or warehouses-as they collect data on everything from production processes to equipment performance. All this data can be used to identify inefficiencies, predict needs for maintenance, and optimize operations in many processes, and therefore, becomes a critical component of the modern industrial systems.

Here, the question of who owns the data resulting from the operation of a robot system arises, which is, far from being an easy question. Often, many parties can make legitimate claims to the data created - namely, the operator of a robot, the manufacturer of a robot, and the developer of the AI algorithms used in processing such data.

Data Ownership Disputes

One of the most contentious issues within the robotics industry revolves around ownership of data produced by AI. For instance, a manufacturing company using the robots to automate the production line would argue that it owns the data simply because it owns the factory and the equipment. However, such a company that created the algorithms for AI running the robots may argue that it owns all this data because the algorithms are those that put it into process and analysis.

This gets complex in the case of data, which is mainly used to train machine learning models that are pre-requisites to an advanced improvement in AI-driven robots. If the data is claimed to be owned by more than one party, it will definitely limit access to important information and thereby retard the development of more advanced robotics systems.

3.5. The Impact of Trade Secrets in Robotics

Trade secrets are also another critical aspect concerning intellectual property protection in the robotics industry. A trade secret refers to confidential business information that puts a company at an advantage over its competitors. As opposed to patents, the information protected as trade secrets must not be made public; rather, it needs protection for as long as it remains confidential.

Trade secrets in robotics can also include proprietary algorithms and manufacturing processes, even data acquired by the robots. Companies may often opt to keep their innovations as trade secrets rather than patents for fear of public disclosure.

Besides that, trade secrets protection itself is already a problem for the robotics industry. Once robots become more and more integrated in industrial processes, they also generate and rely on enormous amounts of data. The confidentiality of that data is key to maintaining competitiveness, however; it would require strong data protection techniques, starting with encryption and secure storage.

Third, the strength of trade secret protection is not as strong as that of a patent, especially where the enforcement mechanisms are weak. Companies relying on trade secrets require intensive protection because the theft or unauthorized disclosure of trade secrets could result in significant financial losses.

---

4. Proposed Solutions to IPR Challenges in Robotics

4.1. Reforming Patent Law for AI-Driven Innovations

Updating the guidelines of a patent office in accordance with unique AI characteristics would be important in patenting AI-driven robotics innovations to overcome issues arising due to patenting AI-driven robotics innovations.

• Elastic Patent Claims: Patent offices may legalize elastic claims for patents that cover both the hardware and the software parts of robotic systems. All aspects of robotics technology should, therefore be well-guarded, including the AI algorithms driving the functionality of robots.

•AI-Specific Patent Rules: Defining well-set rules of determining which AI-generated invention qualifies for patent protection can be able to overcome the complexities arising out of patenting AI-driven innovations. Some guidelines which should consider including criteria regarding novelty and inventive step of the AI-generated inventions and may also refer to the role played by human beings in the inventive process.

•Tiered Patent System: A tiered patent system would ensure that all hardware, software, and AI parts of the robotics technology get varying levels of protection. It would guarantee that

each robotics innovation would be protected while keeping in mind that all the systems are different due to the software aspect.

4.2. Establishing Clear Ownership of Autonomous Creations

To clear the legal ambiguity on the ownership of creations by autonomous systems, a number of remedies that have thus far been considered feasible include:
•Human-AI Co-Inventorship: In cases where the AI system invents something solely on its own, both the AI inventor and user should be regarded as co-inventors. In this way, everyone involved in the invention would be treated equally by allowing everyone to reap what they have sown.
• New legal categories for AI-generated works- It might be able to create new legal categories for AI-generated works, whereby corporate entities can even own intellectual property. This will clearly identify who owns and gets held liable when AI systems are primarily creators.
• Electronic Personhood: Electronic personhood has been proposed as well as a way to confer rights in law to very advanced AI systems. In this, such AI systems would own the intellectual property, and may enter into contracts, with liability for damages. This concept, although against the mainstream view, might be the future towards handling the complexities of AI-generated works.

4.3. Data Ownership Frameworks

Quite a number of solutions have been proposed to address the issue of ownership of data in AI robotics:

- Data-Driven Patents: If data were to be regarded as an integral component of the functionality of the AI-based robots then, it would make sense to regard data as an asset patentable. In that manner, high-quality datasets would be encouraged with safeguards for the rights of data generators.
- Blockchain for Data Ownership: Blockchain ensures that who owns the data can be tracked, and for what purpose and in what manner the data is being shared among other stakeholders. Blockchain can eventually enable stakeholders to securely share data while not losing control over its usage.

4.4. Licensing Models for Software-Driven Robotics

This will render conventional licensing models archaic because such innovations are peculiar to the nature of software-driven innovation. There is what is known as "dual licensing" whereby companies sell their software under both open-source and proprietary licenses.

Under this model, the open-source version of the software is available without charge for non-commercial use, while the proprietary version is sold exclusively for commercial use under a licensed scheme. Its successful usage in the software industry is highly associated with AI and machine learning platforms but currently applications in robotics are at an infancy stage and

involves a great give-and-take between showing where to be more collaborative and intellectual property protection.

4.5. Strengthening Trade Secret Protection

The trade secrets in robotics must be well protected as well; therefore, the companies must ensure firm data protection measures that include encryption, secure storage, and access controls. Trade secret laws and provisions for enforcement should be strengthened by the governments against the theft or wrongful disclosure of confidential information.

For example, in a system where trade secrets have poor protection mechanisms, companies would rely on other forms of intellectual property protections to safeguard their innovations, such as patents. Nevertheless, the choice between patent and trade secret protection depends solely on the nature of the innovation and the extent of confidentiality required.

---

5. Conclusion

In integration of robotics technology with industrial automation, intellectual property rights, to some extent, will have mixed fortunes both in terms of opportunities and challenges. This is because increased AI systems require old IPR frameworks to be reviewed in matters of patentability, ownership, data rights, and licensing as they present complicated issues. The adoption of such novel solutions as patent claims sensitive to fluctuating change scenarios, models of shared ownership, and blockchain technology for data management ensures that intellectual property laws catch up with the rate at which robotics technologies are fast-evolving.

The other important aspect is a flexible legal structure to accommodate new inventions and patents while still respecting the rights of inventors and adopting a collaborative and innovative approach. The unbridled full potential of this transforming technology will only be developed when the issues of IPR in robotics are addressed.

References

- Ballestar, M. T., Garcia-Lazaro, A., Sainz, J., & Sanz, I. (2022). *Why is your company not robotic? The technology and human capital needed by firms to become robotic*. Journal of Business Research. DOI: 10.1016/j.jbusres.2021.12.061.
- Turuta, O., & Zhydkova, O. (2021). *Problems of Policy Regulation on Robotics*. Journal of Legal Studies. DOI: 10.24144/2307-3322.2021.65.2.
- Keisner, A., Raffo, J. D., & Wunsch-Vincent, S. (2016). *Robotics: Breakthrough Technologies, Innovation, Intellectual Property*. Foresight Journal. DOI: 10.17323/1995-459X.2016.2.7.27.