

Intellectual Property In The Fourth Industrial Revolution Era

By Dooky Kim

I. Introduction

Intellectual property law creates exclusionary rights based on the results of human intellectual activities. Intellectual property exists in various forms.

Technological innovations are essential to the development of industries and can be protected as intellectual property, specifically by patents. The patent system calls such technological innovations inventions and those who created such inventions inventors. Inventions include product inventions and method inventions and, either way, they must be new and involve an inventive step (meaning not easy to think of) to be patentable.

Literary works and artistic works can also be protected as another category of intellectual property, namely copyright. Copyright covers works such as writings, songs, paintings, software, and many other various types of works. The copyright system protects the particular expressions in the covered works, as opposed to processes, facts, or ideas contained therein. Those who created the works are called authors.

Symbols designed to indicate the source of commercial goods or services are protected as trademarks.

These three major areas of intellectual property—patent, copyright, and trademark—have been functioning well so far through the First, Second, and Third Industrial Revolutions. However, many commentators have expressed their concerns about whether the traditional intellectual property systems could properly protect human intellectual works in the evolving era of the Fourth Industrial Revolution.

II. Fourth Industrial Revolution and Key Technologies

Recently, a rapid transition to the so-called Fourth Industrial Revolution has been driven by a few essential groundbreaking technologies, including artificial intelligence (AI), the internet of things (IoT), and 3D printers.

Artificial intelligence is not a new concept but at least 60 years old now. However, it has recently made great strides due to the introduction of deep-learning technologies and big data. People long believed that certain human tasks could never be properly performed by computers. Such tasks include language translation, playing Baduk (Go), recognition of faces, and reading emotion from facial expressions. However, with the recent development of deep-learning technologies, people started believing that sooner or later artificial intelligence will replace human intellectual labor in most areas, just like in the First Industrial Revolution when machines replaced human physical labor.

In some areas, artificial intelligence already outperforms human brains. We recently witnessed a computer powered by AI win Baduk (Go) games against a human Baduk (Go) champion. In other areas, artificial intelligence performs, or is expected to perform in the near future, intellectual tasks just as well as humans can do. The use of machine translation is yet limited, but the quality of machine translation is being rapidly improved with the help of artificial intelligence. Self-driving cars as well are no longer just in science fiction movies.

Artificial intelligence will make conventional products smart and smart products smarter. We will be shopping for smart cars, smart refrigerators, and smart everything in the market. Smartphones and smart TVs will become much smarter. The beauty of artificial intelligence is that its deep-learning capability enables it to improve by means of self-learning.

IoT technologies will also make a significant change to smart products. Traditionally, electronic and automated devices have mostly relied on their own CPUs and software installed locally to perform their tasks and functions. This physical restraint has limited the full usage of artificial intelligence as artificial intelligence installed in an isolated, individual device could only learn from its own experience. Self-improvement would be very slow.

However, significantly enhanced interaction and communication between devices and servers enables individual devices to share artificial intelligence installed in a single remote server or a small number of remote servers. The centralized CPU/GPU can conduct important calculations, or make judgements or decisions, for all the individual devices, and most importantly can learn from all the experiences of the individual devices, which enables it to self-improve at very fast speeds.

3D printing will also make fundamental changes to the way that commercial goods are traded. In traditional commerce, products were first manufactured in manufacturing facilities, displayed or advertised, and then purchased by consumers. Consumers had to pick up the products in off-line stores or have them delivered to their homes from on-line stores.

However, with 3D printing technologies, product designers will be able to display or advertise their product designs without actually manufacturing the products, and when consumers purchase their designs the designers will just need to send their product designs in electronic formats to the purchasing consumers. Then, the consumers will have 3D printers “print” the products as the de-

signers designed. Accordingly, a higher availability of 3D printing technologies will replace traditional manufacturing facilities and distribution channels in many industries.

III. Fourth Industrial Revolution and Intellectual Property

1. AIs and Patent

The traditional patent system may not be able to properly adapt to the new types of inventions being created. Inventions with artificial intelligence involved in their creation can be categorized into three groups:

- **Category I:** Inventions (products or processes) as to artificial intelligence itself. New processes (algorithms) of deep-learning or deep-learning structures will be examples of process inventions belonging to Category I. New hardware that can help enhance the performance of artificial intelligence can also belong to Category I.
- **Category II:** Inventions (products or processes) for which artificial intelligence performs a certain function as an essential element of the inventions. New healthcare devices or software with artificial intelligence performing the diagnosis can be examples.
- **Category III:** Inventions (products or processes) designed by, or with the assistance of, artificial intelligence. Any new products designed by artificial intelligence will belong to Category III. Artificial intelligence, which is software, may also develop or create another application or piece of software.

Category I Inventions

Category I inventions do not involve new ways of creating inventions although such created inventions themselves may be of a new type (AIs). They are created just like other software and process inventions were traditionally created, and will be treated just like the other traditional software, process, or product inventions. Therefore, the traditional patent system will have little problem or issue dealing with Category I inventions.

Category II Inventions

Category II inventions, however, are unlike the traditional products or processes assisted by traditional software. They may have similarities in that they both let their CPU/GPU or software perform certain functions, but they have fundamental differences too. The traditional CPU/GPU or software would perform the same functions the same way all the time. Therefore, with the same conditions (same inputs), the results (outputs) would be the same. However, artificial intelligence may not perform the same functions the same way even under the same conditions. This is so because artificial intelligence is designed to self-learn and self-improve. As it “experiences” more it is supposed to perform the same function a better way or produce a better performance.

Due to this, the traditional patent system may fail to properly accommodate this new type of inventions because it requires inventions to have what is called “re-

peatability.” The inventions must operate the same way, and produce the same output, when the input and conditions are the same. However, the AI-operated part/function is like a black box in that we cannot predict how it will do its job. An AI-assisted healthcare device, for example, may determine under a certain set of conditions that a user has a health issue, and later determine that another user or even the same user does not have a health issue under exactly the same conditions. Similarly, an AI-assisted translator device may translate an expression to a certain expression in another language, and later to a different expression. AI-assisted inventions by nature could not meet the repeatability requirement.

■ Dookyu Kim,
S-Printing Solution,
(HP Global Legal Affair),
Senior Legal Counsel,
Suwon, Korea
E-mail: dookyu.kim@hp.com

In order to encompass Category II inventions within the patent regime, the patent system should renounce the “repeatability” requirement. If this is what we want, we will have to have a new patent system. On the other hand, if we were to maintain the traditional patent system, which includes the repeatability requirement, most Category II inventions would be excluded from patent protection. This is not an easy call and either option has its pros and cons. Regardless, we cannot have it both ways, and must make a choice.

Category III Inventions

With Category III inventions, we do not have repeatability problems. Once a product or process is designed by artificial intelligence, such designed product or process becomes a new invention that performs its functions the same way all the time unless it itself includes another AI component that performs those functions. (In this case the invention will belong to Category II as well as Category III.) It is true that the same artificial intelligence may create a first design and later a second, different design, functioning differently. However, they are separate and different inventions, performing functions a repeatable way on their own.

Instead, Category III inventions raise another significant legal issue, that of inventorship. Traditionally, the patent system has recognized only natural human beings as inventors. In addition, machines could not hold titles to property in general. Therefore, artificial intelligence, which actually created the inventions, could not be an inventor. Likewise, however, those who designed and created the AIs, which in turn created the inventions, could not be the inventor because they did not themselves create the inventions. Finally, for the same reason, merely because somebody owned or operated the AI when it created the inventions, she could not be an inventor again because she is not the one who created the inventions using her own intelligence. Accordingly, no one could claim inventorship to inventions designed by artificial intelligence in the traditional patent system.

Even in a new patent system that we can imagine for the near future, AIs will not be able to be inventors holding title to proprietary patents. Therefore, the practically possible candidates for inventorship with regard to Category III inventions will be the creator or designer of the AI that created the inventions, or the owner or operator of the AI when it creates the inventions. Logically the latter would be the better candidate because they are the most closely involved in the activities of creating the resulting inventions.

2. IoT and Patents

In the traditional patent system, patentees may struggle to enforce their rights in their patented smart products or processes, mostly belonging to Category II, when the allegedly infringing products or processes work with remote servers operating on an AI basis. This is so because in the traditional patent system, only those who make, sell, use, offer for sale, or import the whole patented products without the permission of the patentee would infringers. In addition, in the case of process patents, users of the entire patented process without permission would be infringers. The infringers need to be single entities that carry out the patented inventions as a whole. In principle (with limited exceptions), those who only partially practice the patented inventions are not infringers.

Where remote AI servers are involved, the smart products would be within the control of end-users (consumers) when they are used and within the control of the suppliers when they are manufactured or sold, while the remote servers themselves would be within the control of server operators. The server operators may not be at the same time the suppliers of the smart products, in which case the patent owners will have difficulties in pursuing patent infringement litigation.

The smart product suppliers may argue that they did not infringe a patent because they did not participate in the performance of the server-performed functions, which are essential elements of the patented invention, when they made or sold their products. The server operators may likewise argue that they did not use the smart products when they operate the server. Finally, it is end-users (consumers) who are more likely to be found liable for infringement as they are involved both in using of the smart products and initiating of the remote server to operate. However, it is very burdensome to sue a number of individuals, and more importantly patentees may be reluctant to sue end-users because in many cases they are potential consumers of the patentee's own products.

The situation becomes worse if the remote server is located in a different country because patents can only be enforceable and infringed in the country where the patents are issued.

Therefore, in the traditional patent system, it will become more difficult for patentees to enforce patents on smart products as IoT technologies are improved and more widely used. The traditional patent system does contain a few principles, such as so-called "joint infringe-

ment," "contributory infringement," and "inducement of infringement," which could possibly be employed to address some of these issues. However, the current principles are too rigid and inflexible to solve the problems entirely. In a possible new patent system, the principles should be more flexible.

3. 3D Printers and Patents

In many industries, 3D printing technologies can obviate traditional manufacturing facilities and distribution channels, and instead consumers will have 3D printers "print" the products. Traditionally, those who supply the infringing designs would not be direct infringers because they do not technically "make" or "sell" the patented products. The consumers are the ones who "make" and "use" the patented products.

Patentees can sue the consumers for infringement, but it would be very burdensome to sue a number of individuals. In addition, patentees again would not want to displease their potential customers. Patentees can instead sue the design suppliers for inducement of infringement or contributory infringement. However, such indirect infringement doctrines have limitations and in some situations would not be available.

4. AI and Copyright

Otherwise copyrightable works could also be created by artificial intelligence. Many expect that in the near or far future AIs will be able to write novels and songs or paint pictures as well as human beings. Such works will be similar to Category III inventions as discussed above, and will have similar legal issues regarding authorship.

In the current copyright system, no one can claim authorship to works created by artificial intelligence. This issue can only be solved by legislation. In a new copyright system, those who own and operate the AI when it creates the works could be considered authors. When we want to adopt a new copyright system, we should bear in mind that AIs may be able to create a number of works within a very short period of time.

V. Conclusion

As with many traditional systems currently, the traditional IP system is not designed or adapted to cope with the Fourth Industrial Revolution. But now is still an early stage to decide exactly how to modify the patent, copyright, and other IP systems to adapt to the new and evolving era. Legislative efforts do not always function as intended. Many times we have witnessed them not only failing to solve the intended problems but also producing more serious side effects.

We may or may not conclude to change the current IP system or other legal systems. Either way, we at least need to start discussing the new phenomena that we will face in the future that the new technologies will bring us shortly and considering the consequences of those changes. ■

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