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A Study on AI Creations and Patent Law Protection

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Abstract. The process of conceiving an invention, how AI may contribute to the conception process, and how AI inventions should be protected by patent law are examined. In our approach and analysis, AI remains in the category of sophisticated tools used by natural persons to create inventions. The approach is assessed against a decision by the Australian Federal Court acknowledging that the AI machine DABUS can be held as an inventor. As a result of our study, however, we believe that it is at least questionable whether DABUS can be considered an autonomous inventor. Thus, in those cases where someone names an AI machine as the inventor, we propose setting a high standard of proof in requesting to produce as evidence the actual machine output claimed as the invention and to illustrate how the machine operates to arrive at such output.

Keywords: Inventorship, AI, Patent.

1 Introduction

Today, with the rapid progress of AI technology, the debate on AI creations is increasingly alive with attention being paid to the case of DABUS, a patent application filed in many countries around the world and naming AI as the inventor. In the DABUS application, several jurisdictions have denied the possibility of naming a machine as the inventor, while other jurisdiction like Australia have allowed it, thus further fueling the discussion as to whether patent rights shall be granted to an AI invention, and, if so, to whom the patent rights should belong. However, there are very few cases where AI has autonomously made inventions. In this paper, we examine the process of conceiving an invention, how AI can invent or contribute to the conception process, and then consider how AI inventions should be protected by patent law.

The present article reflects only the personal opinion of the authors and not necessarily those of the organizations with which they are affiliated. Further, the authors do not endorse any product or service herein mentioned.

2 Definition of inventor

Japanese Patent Law stipulates that a person who has made an invention that can be used for industrial purposes is entitled to a patent, see Article 29, paragraph 1. Under this provision, it is understood that a natural person who truly invented can be an inventor [1]. However, the definition of an inventor is not stipulated in the Patent Law and is left to academic theories.

Nakayama [2] states that "An inventor is only a person who has actually participated in the creative act of the invention".

Regarding the criteria for judging joint inventors, Yoshifuji [3] writes: "Since invention is the creation of a technical idea, the existence of substantial cooperation must be judged exclusively from this perspective. A person who is not involved in the creation of the idea itself, such as a mere administrator, assistant, or patron, is not a joint inventor.

3 Examination by the Japanese government

In Japan, in response to the recent rapid development of AI technology, the "Next Generation IP System Study Committee Report" was compiled in 2016 [4]. Figure 1 shows the treatment of AI creations in the current IP system. Based on this report, creations and rights to be named as inventor are classified as follows:

- (a) Creation by a natural person: Rights arise.
- (b) Creation using AI as a tool: Rights for the natural person arise when the AI is generated by the creative intention and creative contribution of a natural person.
- (c) Creation by AI: If human involvement cannot be regarded as a creative contribution (e.g., mere encouragement of creation) and AI is not evaluated to have generated the work autonomously, no rights arise.

The report further states that it is usually difficult to distinguish between a creation by a natural person and by AI. The difference between the two is in the process of creation, and not in the creation itself. For this reason, unless it is clearly stated that the work is an AI creation, it is treated as if it were a creation by a natural person. At any rate, given the increased availability and performance of AI tools, there is a possibility that IP rights may increase exponentially. The report also states that, since IP rights are exclusive, by treating AI creations in the same way as those made by natural persons, there is a concern that those who have access to such AI tools may more easily monopolize vast amount of information and knowledge, importantly – we add – without requiring the endeavors, dedication and time (more precious to man than to a machine) that a human would need to arrive at a creation.

In short, the report raises the concern that the use of AI may unnecessarily inflate the number of inventions and related patents possibly without sufficiently justified efforts.

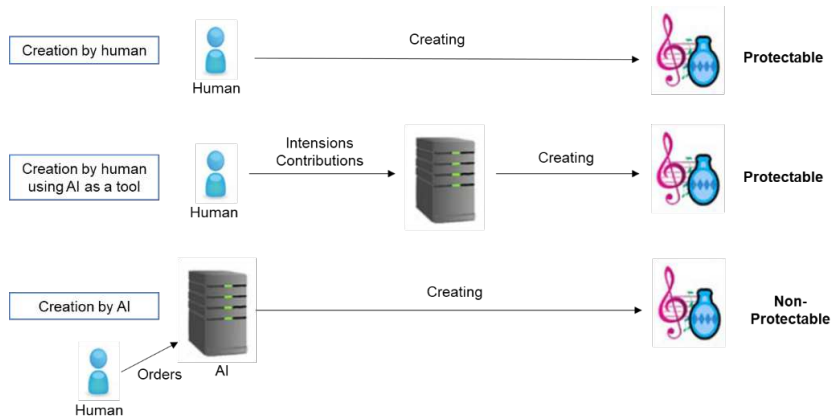


Fig. 1. Treatment of AI creations in the current IP system.

4 Conception of inventions and AI

4.1 Assumptions

In this paper, we focus on AI inventions created by natural persons using AI as a tool, see case (b) above, presently being a technologically realistic scenario. The analysis will proceed as follows: Firstly, we examine the processes that lead to the conception of an invention. Secondly, we analyze which processes can be carried out by a natural person or by AI. Then, we attempt to examine the creation of inventions from the perspective of creative intention and creative contribution. In this way, we believe that it is possible to find a solution to the concerns expressed above.

4.2 The Processes Leading to an Invention

In general, conception and reduction to practice are present when a natural person comes up with an invention. Leaving aside the reduction to practice, and simplifying, the activities leading to an invention and to the filing of a patent application may be considered to consist of the following processes (1) to (7) [5]:

(1) Identification of the facts to be solved

The facts may include technical issues, social needs, and mere human desires. In reality, there may be various mental steps that lead to these facts. However, we are herein not concerned with the thinking steps as such, but rather with the facts to be solved thanks to the invention.

(2) Investigation of conventional technology and clarification of related problems

Most inventions are created based on conventional technologies. In this process, conventional technology is investigated, the problems that cannot be solved are clarified, and preparations for the conception are made.

(3) Conception

Conception represents directions for solving a problem and means for arriving at the solution to a problem beyond the idea. This process is the core of the activity leading to one or more inventions.

(4) Reduction to practice

This is the process of considering how to realize the solution to the problem that has been conceived.

(5) Realistic production of the problem-solving means

The feasibility of the problem-solving means is confirmed through actual experiments and/or verifications.

(6) Invention discovery and pre-filing search

Through a pre-filing search, the part of the conceived solution that is perceived to overcome the problems of the conventional technology and to satisfy patentability requirements (novelty, inventive step, etc.) is extracted as the invention.

(7) Conceptualization (of technical ideas)

The invention is completed by expressing the technical features of the conceived solution in the form of claims.

4.3 Examination of the Roles of Natural Persons and AI when Conceiving inventions

Before conception.

In process (1), we consider that not only a mere command to "invent" but also "specific instructions" are necessary. The specific instructions are equivalent to the "motivation" for the invention, and include technical issues, requirements of natural persons, etc. For example, in the currently realized automatic composition device [6], it is necessary to input the "motif" of a piece of music when the device composes it. This motivation is recognized as the creative intent of a natural person.

In process (2), a natural person is required to provide an algorithm to the AI in order to come up with an idea, the algorithm causing e.g. to learn conventional technology, understand and clarifying problems. For example, in the project where an AI called "TouRobo-kun" solves a university entrance exam problem, a natural person designs the algorithm for the AI to come up with the solution to the problem [7]. In other words, through the design of the algorithm, the natural person contributes to the process by which "TouRobo-kun" comes up with the answer. Usually, it is not easy for an AI to come up with an algorithm by itself, but it must be provided by a natural person so that the AI can learn. We will call this process "pre-learning", which is necessary for AI to come up with an idea. Pre-learning is done by a natural person for an AI, and we believe that part of the "creative contribution" of a natural person is recognized here.

Conception.

The idea in process (3) is conceived by AI based on the conventional technology obtained by applying the algorithm from process (2). It is not possible to describe exactly

what kind of actions the AI take, but we believe that such actions are based, for example, on the optimal combination of a huge amount of information that cannot be handled by a natural person.

Reduction to practice.

In process (4), the AI presents how to materialize the idea, and in process (5) it actually conducts experiments and verifications. An invention is a “creation of a technical idea” (Article 2(1) of the Japanese Patent Act), and in this regard, Takabayashi [8] states that an invention “must be feasible and repeatable as a means to achieve a certain goal, since it is a technology”.

The fact that a natural person provides specific instructions to an AI means that the natural person naturally expects to implement the AI invention. However, in process (5), it is necessary for a natural person, who is the subject of implementation of the invention, to verify the possibility of implementation. This work is considered to be part of the creative contribution of a natural person.

In U.S. case law [9], the idea requires recognition of both existence and appreciation of value. Applying this precedent to the case under examination, the moment when the AI understands the idea output from the AI itself is the moment when the “existence” is recognized, and the moment when the feasibility of the idea is confirmed as a result of verification is the moment when the “value” is recognized. In other words, process (5) is usually carried out by a natural person, and the natural person is considered to be involved in the conception of the AI.

After reduction to practice.

In processes (6) and (7), AI extracts patentable parts (mainly the novel parts with attempts to guess the possibly less obvious parts) based on the learned conventional technologies. As for the preparation of documents like a patent application, a semi-automatic specification generation system may be used [10].

4.4 Discussion.

Table 1 summarizes the processes leading to an invention and the roles assumed in each process. Specifically, the natural person provides specific instructions in process (1), prior learning in process (2) (e.g. provision of algorithms leading to conception and learning of conventional technology), and verification of an embodiment in process (5). The creative intention of natural persons is recognized in process (1), and the creative contribution of natural persons is recognized in processes (2) and (5). We believe that processes (1), (2), and (5) are the roles of natural persons that are indispensable, perhaps no matter how advanced AI technology becomes, at least for certain types of inventions; the DABUS case seems to challenge this assumption and we will discuss it later. Thus, we believe that at least based on present evidence it should not be expected that an AI machine will be able to invent autonomously anything based on mere instructions from a natural person, i.e. inventions should still be treated as made by humans assisted by highly sophisticated AI tools. To those naming AI as the autonomous inventor, a high

standard of proof should be requested to show that this is the actual case. If the number of autonomous-AI inventions should then significantly increase, further policy considerations may have to be taken into consideration as to which type of rights might arise.

Table 1. Invention process and assumed role assignment

Invention process		Assumed division of roles	
1	Identification of the fact to be solved	Human	Input assignments into AI
2	Investigation of conventional technology and clarification of problems in conventional technology	Human AI	Human to AI to perform pre-training
3	Conception	AI	Combining vast amounts of literature, etc.
4	Reduction to practice	AI	Output the concept
5	Realistic production of the problem-solving means	Human	Demonstration by a natural person
6	Invention discovery and pre-filing search	AI	Confirmation of patentability
7	Conceptualization (of technical ideas)	AI	Output the completed invention

4.5 The "Use as a Tool" Requirement: A Comparison with a Circuit Simulator

The previous section discusses the case of a natural person using AI as a tool, which may be compared to a simulator used as a tool for generating an electronic circuit.

A circuit simulator of this type can be described as a device to which a desired function or a higher-level logic circuit is input. The simulator then automatically outputs an optimized circuit by taking into account constraints or conditions, like e.g. the number of transistors, the size of the circuit, calculation speed of the critical path, etc. In the process of designing a circuit using such a simulator, a natural person may design an initial circuit; the simulator solves various constraints to realize and finalize the circuit. In this respect, circuit simulators and AI have something in common in that they automatically output optimal results.

In the case of an AI outputting an invention, a natural person provides the creative intention, in particular by imputing algorithms leading to the facts to be solved, and the creative contribution, in particular the prior learning, so the AI is used as a tool.

By comparison, in the case of a circuit simulator, a circuit is completed by optimizing some numerical calculations against the design by a natural person. In this case, the natural person gives the circuit simulator the creative intention (constraints to be solved) and the creative contribution (circuit design), so that we can say that the circuit simulator is used as a supplementary tool.

Hence, both the AI and the circuit simulator are essentially software tools used by man to more quickly complete certain tasks.

5 Examination of inventors and right holders

5.1 Setting of the model

From the development of the AI platform to the completion of the AI related inventions, several actors intervene:

- (A) Developer: A programmer who develops the AI platform.
- (B) Owner: A provider of the AI platform, e.g., a company to which the developer belongs.
- (C) Purchaser: A person who purchases the AI platform and owns the AI that has been pre-trained.
- (D) Educator: A person who provides pre-training to the AI platform.
- (E) User: A person who intends to use the AI to make inventions.
- (F) Verifier: A person who verifies the output of the AI.
- (G) Big data owners (as represented by the managers).
- (H) Owner (managers) of AI parameters.

In this paper, we assume that the above to be all different actors.

Figure 2 shows the flow from the development of an AI platform to the completion of an AI invention. The left side of the figure corresponds to the developer and the right side corresponds to the user. First, the developer (A) develops the AI platform, which is owned by the owner (B). The platform is then transferred to an individual or company (C) that intends to use it. The platform is pre-trained by an educator (D) so that it is suitable for a specific type of use. After the pre-learning is completed, the platform is used by the user (E). The output generated in the process of use is verified by a verifier (F). The big data and AI parameters generated in the process of pre-training and the invention are managed by their respective owners (G, H).

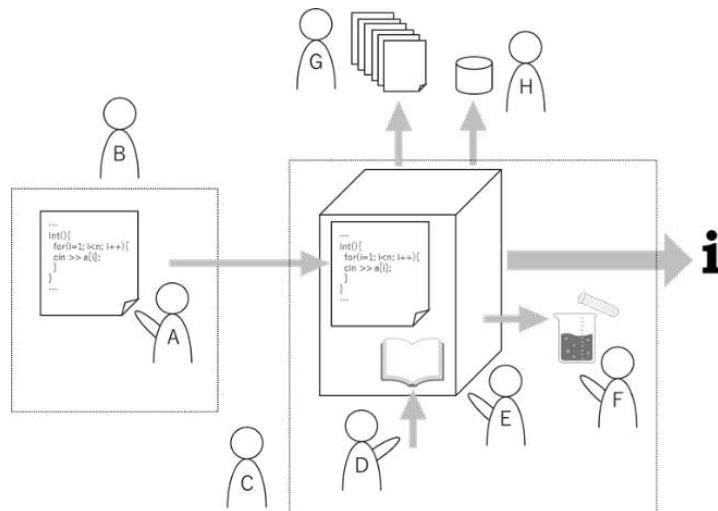


Fig. 2. Study model

5.2 The Role of Natural Persons

In Section 4.3, we considered that processes (1), (2), and (5) are performed by or involve natural persons. In this section, we examine which of the agents are specifically responsible for these processes.

In process (1), a natural person, the user (E) of AI, inputs specific instructions to the AI.

In process (2), it is necessary to provide prior learning to the AI. The essence of pre-learning is the construction of learning data and tuning of AI parameters to obtain optimal AI parameters. We believe that the role of the educator (D) is extremely important in this process.

Process (5) is to verify the feasibility of the idea based on the AI output. The verifier (F) is involved in this process.

However, the developer (A) and the owner (B) are involved in the AI platform, but they are not involved in the invention itself. As for purchasers (C) and owners (G, H) of big data or AI parameters, it cannot be said that they are substantially involved in the invention, since they are mere owners or administrators.

5.3 Inventors and Patentees

AI inventions as herein considered are in the category of "use as a tool" available to natural persons. Therefore, we assume that the inventor is also a natural person who uses AI as a tool. In the case of "use as a tool," it is necessary to give creative intention and creative contribution to the AI invention. Specifically, the former is the input of specific instructions, and the latter is the provision of prior learning and verification of the feasibility of the idea. From the discussion in the previous section, the educator (D), the user (E), and the verifier (F) fall into this category. Since each of them is assumed to be a different actor, it is appropriate to consider all of these actors (hereinafter referred to as "users") as joint inventors. In addition, based on the U.S. precedent that "if a computer cannot be an inventor, a natural person who recognizes the existence and value of the invention can be an inventor" [11], it is appropriate to consider the users as inventors.

With respect to the patentee, according to the Patent Law, unless the right to obtain a patent is transferred (Article 33, Paragraph 1) or special provisions regarding employee inventions (Article 35) are applied, the right to obtain a patent arises with the inventor, and the inventor is given the patent. As applied to this case, the patent right belongs to the user, from the beginning.

For completeness, we note that usage patterns different from the above may also be considered, in which case the person who made a substantial contribution to the invention will also be different. Further, depending on the starting point of the model, one may also view the developer of the AI platform as an inventor because of his/her contribution being essential to the conception of the invention.

Therefore, while maintaining the principle that the patent belongs to the original user, we believe that it should be allowed to determine who should be recognized as the inventor in each mode of use through contracts or agreements.

6 Examples of patent applications naming AI as inventor

In 2018, two patent applications were filed with the European Patent Office (EPO) naming DABUS, a non-natural person, as the inventor. These applications have since been filed in many countries around the world. Many patent authorities, including the EPO, rejected the applications because the naming of the inventor did not meet the legal requirements. On the other hand, the Republic of South Africa [12] and Australia recognized DABUS as an inventor.

DABUS is a complex software architecture that may be described as the combination of two artificial neural networks. The first network generates notions as a consequence of internal or external perturbations. The second network analyzes the output of the first network and assesses its novelty, utility or value, and selectively reinforces the way the first network is perturbed so that notions having higher prospects of being novel, useful or valuable can be produced. Simplifying, the first network may be thought as a sort of chaotic generator of ideas, with the second network judging the output from the first and educating the first to produce better results so that ultimately the creation of valuable and non-random ideas is achieved. Allegedly, the system – once trained – can freely run to produce notions in the sense of inventions [13].

6.1 Judicial Decision of the Australian District Court

On July 30, 2021, the Australian Federal Court annulled the decision of the patent authorities to reject the DABUS application and referred the application back to the Patent Office [14].

In the judgment, the Court addresses the technology behind DABUS stating that it is an autonomous system and its output is the claimed invention, see marginals 30-47. The Court also states that constraints on the concept of inventorship would stifle innovation in various fields, based on the example of the use of AI in the pharmaceutical field, see 56.

Additionally, the district court finds that AI can be recognized as an inventor mainly because of the following reasons (for additional details, refer also to [15] [16]).

There is no specific provision that explicitly denies the proposition that AI can be an inventor, see 119.

Unlike copyright law, which includes the requirement of human authorship and the existence of moral rights, there is no specific aspect of patent law that encourages an interpretation that excludes non-human inventors, see 120.

The term "inventor" is not defined by law or regulation and thus has its ordinary meaning, see 121.

It is consistent with the purpose of the Act to construe the term "inventor" in a manner that encourages the publication and dissemination of innovations and their inventions by means of rewards, regardless of whether the innovation was made by a human being or not, see 124.

Similar to Article 2A, the right to computer inventions will encourage the development of creative machines by computer scientists and developments in the facilitation

and use of the products of such machines by others, leading to new scientific advantages, see 125.

The Court assumes that DABUS would be autonomous, including the selection of input data, the setting of goals, and the choices and paths to reach those goals, see 127. It then states that such AI systems are not mere tools but operate at least semi-autonomously, see 128. Furthermore, the district court states that it would be better to recognize the AI as the inventor, rather than the programmer, owner, or other person associated with the AI, to avoid uncertainty in the recognition of the inventor, see 131.

It is perhaps important noting that the Australian Court was not apparently concerned with the question of whether DABUS actually generated the invention, but rather with the legal point of whether the machine could be named as inventor. In this legal framework, it might suffice only a preliminary assessment as to whether DABUS can be reasonably held to be the actual inventor.

6.2 Our Proposed Model and Comparison with the Australian District Court Decision

In the following we compare our above model and assumptions, namely that AI remains a tool available to humans for making inventions, against the Australian decision.

Regarding process (1), we considered that the facts to be solved are input by natural persons, without which AI cannot operate. On the other hand, the Federal Court acknowledges that DABUS autonomously invents. Furthermore, since it is "capable of adapting to new scenarios without additional human input," the Court apparently acknowledges that the facts to be solved were also proposed by DABUS. To generate a notion or idea, DABUS is trained based on a knowledge domain, as far as one can derive from US5,659,666 that Applicant submitted to the EPO as one of the documents describing how DABUS operates [17]. Based on this, it is questionable that the machine – and not a person – is the one to have directly chosen the facts, i.e. the knowledge domain on which to work towards an invention. The Australian decision seems to mainly follow Applicant's submissions, in particular that after an initial learning aiming at verifying correctness of first notions by a human, then DABUS can freely run to arrive at the invention. It is however highly desirable ascertaining the boundary of where the human-assisted learning ends and where the machine free-run starts. As a side remark, we wonder whether the outcome of the judicial case would have been different, had it involved an opposing party capable of challenging Appellant's submissions on solid technical grounds. In summary, we believe that it is fair questioning whether and how far it is credible that DABUS can choose the facts on its own.

Regarding process (2), this paper considers that prior learning is the role of natural persons. On the other hand, the decision acknowledges that at least an initial training needs to take place, which may need to be tailored to a specific technical domain, see e.g. US5,659,666. Also here, it is in our view questionable the credibility that DABUS can autonomously perform process (2). Further, the judgment acknowledges that DABUS was designed by the applicant, namely Mr. Thaler. Therefore, this process involved a natural person.

Regarding process (5), this paper considers that the verification of feasibility is the role of a natural person. On the other hand, there is no express reference to this point in the judgment, which rather seems to accept the Appellant's submissions. However, we believe that it is dubious or at least unclear whether this process was conducted by natural persons or by DABUS. The doubts are fueled by the fact that the invention at issue relates to a food or beverage container including a wall having a fractal profile. A fractal is a never-ending pattern that appears the same at different scales, i.e. it is an infinitely small detailed profile that cannot be machined in practice. In this regard, the application states that "It is to be understood that these fractal elements 18-28 have fractal characteristics within practical considerations determined for example by the limits of the chosen manufacturing/forming process, the material [...] In practice, the fractal elements 18-28 will typically reach a minimum practical dimension determined by such constraints.". It is in our view unclear whether such recognition, crucial to the reduction to practice of an abstract – probably artistic – idea, was actually output by DABUS, by a natural person evaluating the output or even by the patent attorney in anticipation of possible objections of an otherwise insufficient disclosure. Probably an analysis of the actual output by DABUS, which would represent the invention disclosure in the case at issue, may help answering this question.

Hence, we believe that there are at least some open questions and legitimate doubts as to whether processes (1), (2) and (5) can be considered to be performed by DABUS. A more detailed and thorough analysis of the actual functioning of DABUS, as well as observation and documentation of its functioning and output seem at least desirable in order to more comfortably conclude that technology is ready to have a machine being the sole inventor.

7 Conclusion

In this paper, we analyzed the inventive acts of AI and concluded that AI remains in the category of sophisticated tools used by natural persons. In addition, we evaluated our approach against a decision by the Australian Federal Court acknowledging that the AI machine DABUS may be legally named as an inventor when accepting the assertion that the claimed invention was indeed the autonomous output of the machine. As a result of our study, however, we believe that it is at least questionable whether DABUS can be considered an autonomous inventor. Thus, in those cases where someone names an AI machine as the inventor, we propose setting a high standard of proof in requesting to produce as evidence the actual machine output claimed as the invention and to illustrate how the machine operates to arrive at such output.

In the future, AI research will progress at an accelerated pace, and groundbreaking inventions may be created using vast amounts of information that cannot be handled by natural humans. Such inventions may contribute to the development and progress of the world, but may also lead to destructive, illegal or detrimental applications. In such cases, it is the reasoning of the natural person who uses AI as a tool that must be questioned; only with the appropriate use of AI can inventions lead to industrial development. Natural persons should take into account the impact of AI-related inventions on

the development of industry and the cumulative progress of technology, and work and apply for patents on their inventions in a responsible manner.

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