Corresponding Author: Ilyas Khan (Assistant Professor, Department of Law, Abdul Wali Khan University Mardan, Mardan, KP, Pakistan. Email: drilyas@awkum.edu.pk)

Cite Us

p- ISSN: 2708-2458 e- ISSN: 2708-2466 Pages: 27 - 35 Vol. VIII, No. II (Spring 2023)

Patent Protection of Digital Technologies for Food Safety Supervision

Li Tian-zhi [*] Ilyas Khan [†] Sobia Bashir [‡]

Abstract: *Digital technology innovations provide important technical support for strengthening and optimizing food safety supervision, which requires the patent system to provide appropriate protection and incentives. The utilization of cutting-edge technologies, namely big data, cloud computing, and artificial intelligence (AI), presents many complexities when ascertaining eligibility for patent protection, evaluating inventiveness and carrying out patent examinations. In light of the matter at hand, it is imperative to enhance the criteria for scrutinizing patent applications of algorithms via legislative measures. Furthermore, it is crucial to bolster governmental endeavours in fostering a cadre of patent examiners with interdisciplinary expertise. Additionally, we must incentivize innovators to augment their contributions to algorithmic innovation while concurrently imposing limitations on the misuse of algorithms. These measures are indispensable to address the innovation requirements within food safety supervision adequately.*

Key Words: Food Safety Supervision, Digital Technology, Patent Protection, Big Data, Artificial Intelligence

Introduction

As a global and long-term issue, food safety involves national security and public health and guarantees social stability and economic development. At the same time, food safety is also complex and diverse, involving numerous disciplines and connections, necessitating interdisciplinary, inter-sectoral, and cross-border cooperation and coordination. Commencing in 2019, the United Nations officially decreed the seventh day of June to be recognized as World Food Safety Day. This momentous occasion serves as a unifying platform wherein nations shall unite their efforts to avert, oversee, and address perils that may arise within the intricate web of the food supply chain. The ultimate objective of this collective endeavour is to enhance the safety standards governing the production and importation of sustenance across the globe.

The platform economy has broken traditional food production and operation constraints regarding rules, geography, and time. It has raised higher demands for supervisory capacity, efficiency, and food safety technology. The prevalence of food safety incidents can be attributed to information asymmetry and the absence of adequate warning mechanisms. It can be argued that the conventional approach to food safety supervision, which relies heavily on manual and empirical methods, is inadequately equipped to address emerging issues promptly and lacks the necessary adaptability. Moreover, this model is confronted with unprecedented supervisory demands and obstacles due to the advent of a novel economic landscape.

Given the expeditious advancement of the digital economy and the unhindered movement of data components and commodities within the marketplace, it has become imperative to undertake reform and innovation in food safety oversight through digital technology. In light of this, numerous nations have commenced utilizing digital technology to construct a more organized platform for food safety management.

[*] Lecturer, School of Marxism, Beijing International Studies University, Beijing, China.
[†] Assistant Professor, Department of Law, Abdul Wali Khan University Mardan, Mardan, KP, Pakistan.
[‡] Assistant Professor, Law College, University of Peshawar, Peshawar, KP, Pakistan.

Citation: Tian-zhi, L., Khan, I., & Bashir, S. (2023). Patent Protection of Digital Technologies for Food Safety Supervision. *Global Legal Studies Review, VIII*(II), 27-35. https://doi.org/10.31703/glsr.2023(VIII-II).04

DOI: 10.31703/glsr.2023(VIII-II).04 **URL:** http://dx.doi.org/10.31703/glsr.2023(VIII-II).04

For example, the US Food and Drug Administration and the US Department of Agriculture have joined forces with industry associations to build a laboratory network consortium and the "Open FDA" platform to promote the sharing of testing data from "farm to fork" throughout the chain (Zong & Wang, 2017); the European Food Safety Authority (EFSA) issues food safety information through the Rapid Alert System "RASFF" (Yao et al., 2021); the UK Food Standards Agency has established a supply chain monitoring system based on blockchain technology and validated the supervision of beef (Lokers et al., 2016).

Food safety has also been a long-standing priority for China. In 2017, the Chinese government released the 13th Five-Year Plan for National Food Safety, which requires the strengthening of technical support systems for testing, inspection, monitoring and evaluation, as well as the strengthening of scientific and technological support and the use of "Internet+" and big data to implement online intelligent supervision. In 2019, the Chinese government unveiled the "Opinions on Deepening Reforms to Strengthen Food Safety". This document explicitly sets forth the objective of advancing the oversight of "Internet + food". It calls for the establishment of a food safety information platform that relies on the analysis of extensive data sets, thereby advocating for the utilization of cutting-edge technologies such as big data, cloud computing, the Internet of Things, artificial intelligence, blockchain, and others within the realm of food safety regulation. The ultimate aim is to implement a system of intelligent supervision.

Notwithstanding the inherent innovative and interdisciplinary characteristics, it is imperative to acknowledge that contemporary technologies, including but not limited to big data, cloud computing, and artificial intelligence, have engendered a myriad of novel complexities within the conventional patent framework. Exploring the problems faced by digital technology in food safety supervision in patent protection and the solutions to cope with them will directly affect the future technological innovation and development of food safety and is worthy of in-depth study.

Patent Protection for Big Data Technology Innovation in Food Safety Supervision

The concept of big data pertains to a comprehensive assemblage of data that, by its sheer magnitude, eludes acquisition, storage, management, analysis, and processing within a reasonable temporal framework through conventional software tools. Food safety big data, on the other hand, is a complex project that integrates the fields and technologies of food engineering, statistical analysis, database information management and computer networks. With the triadic integration of people, machines and things, the way of data production and consumption has changed. While the previous way was that a few people produced data and others consumed it, the current model has shifted to one where all people are not only producers but also consumers of data, which makes big data have the characteristics of 4Vs, namely Volume, Velocity, Variety and Value (Wang et al., 2019). Accordingly, food safety data is also characterised by large data size, fast processing speed, multiple data types and high data value, leading to more diverse ways of processing and mining related data.

The application of big data technology in food safety supervision makes it more convenient, intelligent and efficient and promotes the effectiveness of food safety market supervision. After using sensors, the internet, the Internet of Things and ZigBee technology to collect data from key aspects of food production, procurement, inventory and sales, etc., Using big data technology presents an opportunity to engage in preliminary data processing procedures, encompassing data fusion, data aggregation, and data cleaning. These processes eliminate extraneous noise and redundant data points, thereby enabling the acquisition of more productive and valuable food safety information. For instance, the Bayesian Network can predict food fraud with an accuracy of 80% (Bouzembrak & Marvin, 2016); the Decision Tree can monitor and classify chemical substances in food and can be used for risk monitoring (van Asselt et al., 2018); the Artificial Neural Networks is a data mining approach with high learning accuracy and has been applied in areas such as learning and sensory evaluation of simulated cheese (Langmead & Nellore, 2018).

In 2015, the State Council of China promulgated the "Action Plan for Promoting the Development of Big Data", a comprehensive and systematic initiative to advance the growth and utilization of large-scale data sets strategically. In 2016, the "13th Five-Year Plan for National Economic and Social Development" was formally unveiled, wherein a definitive proposition was made to execute the national big data strategy and expedite the advancement of data resource sharing, accessibility, and utilization. Consequently, it is noteworthy to observe that circa 2015, there was a real surge in the volume of patent applications in the domain of big data within the jurisdiction of China. Nevertheless, it is imperative to acknowledge that the

realm of patent protection of big data technology continues to encounter certain challenges.

The Issue of Patentability of Big Data Technology for Food Safety Supervision

According to the provisions enshrined within the Chinese Patent Law, an invention is defined as a novel technical solution for a product, method, or improvement. Consequently, it is imperative to acknowledge that rules and methods of intellectual activity and unadulterated computer programs and algorithms do not fall within the purview of patent rights.

The fundamental underpinning of Big Data technology resides within the database realm. A mere database can be understood as a manifestation of informational content which falls within the purview of the principles and methodologies of intellectual engagement.

Although today's databases have evolved into "warehouses that organize, store, and manage data according to a data structure", which includes both a collection of data and a database management system, there is still some controversy as to whether such database systems can be the object of patent rights. This is because the database system can still be considered a combination of information representation and a pure computer program. In contrast, only 10% of the computer programs developed worldwide each year are eligible for patenting, and only 1-3% are granted (Piao, 2011).

Furthermore, it is imperative to acknowledge that the long-standing tenet within the realm of patent law dictates that safeguarding abstract ideas is not a viable course of action. Suppose an innovation in the utilisation of big data emerges. In that case, it is imperative to note that if said innovation is confined solely to the algorithmic and strategic aspects of data application, it shall be deemed a mere algorithmic construct and regulatory framework, rendering it arduous to secure protection under the purview of patent law.

The Issue of Inventiveness of Big Data Technology for Food Safety Supervision

Methods or systems based on big data applications that solve technical problems and obtain technical effects, such as improving the accuracy of image recognition and search, can become the object of patent rights. Still, they must also have the inventiveness required by the Chinese Patent Law to be granted.

Generally speaking, the application of big data is strongly related to its application scenario, and its innovation points are mostly found in the custom development of corresponding data mining and data analysis rules to obtain the required information in combination with specific application scenarios. The underlying ideas and algorithms used in this may be common but are only adjusted for the characteristics of different application scenarios regarding formula selection and parameter settings. This may lead patent examiners to believe that such technical improvements in applying big data can be inspired and taught by the prior art and are obvious, making it difficult to recognize inventiveness.

The Long Patent Examination Cycle for Big Data Technology for Food Safety Supervision

The upgrade and iteration of big data technology are fast, from Hadoop to Spark to Flink, which only took more than ten years, far shorter than the 20-year protection period of invention patents. However, the current review cycle for Chinese invention patents is about 22.5 months, which not only takes up much of the patent protection period but may even be longer than the life cycle of some emerging big data technologies.

Therefore, the patent protection of big data technology also needs to provide a patent examination talent guarantee and patent examination standards that meet the characteristics of big data development.

Patent Protection for Cloud Computing Technology Innovation in Food Safety Supervision

In light of the copious corpus of food safety data, it is evident that the modus operandi of oversight is undergoing a discernibly astute transformation. In contrast to online data that can be readily accessed, analyzed, and computed at any given moment, the comparative value of offline data stored on disk is significantly diminished. Due to its inherent characteristics and capabilities, cloud computing offers a robust and formidable framework for examining and manipulating digital information accessible via the Internet. The technology mentioned above cannot only accomplish the computational extraction of numerous distinctive indicators and correlations within the vast expanse of Internet data but also substantially reduce the duration required for analysis and statistical processing of big data. Drawing upon the advancements in Internet of Things (IoT) technology, the utilization of cloud computing has the potential to

establish a robust food traceability system. Such a system would enable comprehensive oversight of the quality and safety aspects of various stages of food production, processing, transportation, packaging, and storage.

Moreover, it can facilitate risk assessment, risk management, and the dissemination of pertinent information in the realm of food safety. When food safety problems are found, they can be recalled, shelved, sealed and investigated promptly to achieve traceability of food destinations. In addition, when the supervisory authorities punish enterprises related to problematic food, they can also use the cloud computing platform to inquire about the information of bad behaviour records.

Professor Liu Peng, the Secretary General of the China Cloud Computing Expert Advisory Committee, has astutely formulated comprehensive and concise elucidations of the intricate realm of cloud computing. As per its extensive definition, cloud computing can be characterized as a prevailing commercial computing model. The statement mentioned above elucidates the concept of task distribution within a computer system, wherein many resources, encompassing a substantial quantity of computers, are employed. This arrangement facilitates diverse applications in their endeavour to access computational capabilities, storage capacity, and information services in a manner that aligns with their specific requirements. In its concise explication, cloud computing refers to providing computing services that are both dynamically scalable and economically viable, readily accessible through a network on an as-needed basis. However, no matter how defined, the core technology is virtualisation technology, massively distributed storage technology and massive data management technology. Whether the patent system can effectively protect these technologies is an important legal issue for innovators.

The Difficulties of Effective Patent Protection for Virtualization Technology for Food Safety Supervision

Virtualization technology is the fundamental underpinning of the intricate ecosystem of cloud computing. As mentioned above, the concept facilitates logical abstraction and the establishment of a cohesive representation of information technology (IT) resources. This includes a fragmented model that partitions a singular resource into numerous virtual resources and an integrated model that amalgamates multiple resources into a solitary virtual resource. Consequently, this framework is the foundational infrastructure for the higher stratum of cloud computing applications. Virtualization technology can be understood as a predominant means of allocating computing resources. Given that the subject matter at hand pertains to the functioning of a tangible system, it is plausible to categorise it as either a product invention or a method invention, thereby rendering it eligible for protection under the purview of patent law.

However, the characteristics of virtualization technology pose a challenge to its patent protection. In the virtualization technology environment, virtual machines are logically linked to physical machines in a many-to-one or one-to-many manner, which makes it difficult to clarify the functional modules relied on to realize each step of this virtualization process at the level of physical entities and makes it impossible to stop the manufacture and sale of unlicensed proprietary products effectively.

Even if the physical entities involved in patent infringement can be investigated, the number of relevant physical entities under virtualization technology and the manufacturers and suppliers to which they belong may be too large, resulting in high costs of maintenance and litigation, making patent maintenance an unaffordable burden for right holders.

In addition, patent law is territorial, and the legal effect of Chinese patent law is limited to the territory of China. Within the confines of this particular premise, a situation arises wherein the physical entity of the virtualization technology purportedly infringing upon intellectual property rights is situated outside the jurisdiction of China, specifically on a foreign server. This gives rise to a difficulty wherein, since only a portion of the technical features of the virtualization, as mentioned above, technology is situated within the borders of China, it fails to encompass the entirety or the commensurate technical features as stipulated by the patent. Consequently, it does not fall within the purview of protection afforded by the patent right, thereby rendering it arduous to establish recognition of infringement under the auspices of Chinese patent law.

The Patentability Issue of Massive Distributed Storage Technologies for Food Safety Supervision

Conventional network storage systems employ a centralized architecture wherein all data is stored on dedicated servers. This approach, however, presents certain limitations. Firstly, the storage servers become bottlenecks in system performance as they struggle to

meet the demands of large-scale storage applications. Additionally, such systems are ill-suited for efficiently handling massive data quantities inherent in cloud computing technologies. Henceforth, it is observed that cloud computing systems frequently encompass a substantial multitude of servers, which employ distributed storage mechanisms for data retention alongside redundant storage mechanisms to guarantee data reliability. Consequently, this configuration enables the system to cater to many users effectively. This effect can be attained by utilizing extensively distributed storage technologies, exemplified by Google's Google File System (GFS) and the Hadoop Distributed File System (HDFS) developed by the Hadoop team.

The data distribution algorithm is one of the core technologies for massively distributed storage, which is used to solve the problems of uniformity of data distribution, the efficiency of addressing, and the overhead of data migration when expanding and reducing capacity. However, according to the Chinese Patent Examination Guidelines, if a claim relates only to an algorithm or a computer program per se, then the claim is a rule and method of intellectual activity and is not patentable.

In this regard, the Patent Examination Guidelines stipulate the circumstances under which claims containing algorithms are patentable and provide guidance for the patent protection of algorithms. It holds that an algorithm or computer program is patentable if it aims to solve a technical problem, uses technical means that follow the laws of nature to control or process an external or internal object, and obtains a technical effect that conforms to the laws of nature. In short, it is necessary to combine the computer program containing the algorithm with the hardware to make it an "application of the algorithm" so that patent protection will not result in the "monopoly" of the mathematical rules and thus will not hinder the technological progress and dissemination of human ideas.

The Patentability Issue of Massive Data Management Technologies for Food Safety Supervision

Drawing upon the revolutionary advancements in distributed storage technology, cloud computing has emerged as a formidable means to facilitate the storage and retrieval of vast data. However, it is imperative to acknowledge that these copious datasets' subsequent reading, retrieval, and analysis necessitate a meticulous and methodical approach. Henceforth, data management technologies employed in cloud computing must be able to administer copious volumes of data effectively. Internet companies such as Amazon, Google, and Alibaba heavily depend on extensive data management technologies, exemplified by Google's BigTable, Alibaba's OceanBase, and HBase, an open-source data management module developed by the Hadoop team.

According to IDC's projections, it is anticipated that the volume of data generated on a global scale will experience a substantial increase from 33ZB to 175ZB within the timeframe spanning from 2018 to 2025. Notably, a significant proportion exceeding 80% of this data will be characterized as unstructured, posing challenges in effective management. Consequently, managing such intricate systems necessitates the utilization of domain-facing programming models, which enable the simulation and examination of these complex systems. Programming models serve as conceptual frameworks to articulate algorithms encompassing strategies and concepts. Consequently, these models may also fall within the purview of regulations and methodologies of intellectual endeavours, thereby rendering them ineligible for patent protection.

Therefore, similar to mass distributed storage technology, mass data management technology also needs to be transformed into an "application of algorithm", i.e. adopting technical solutions, solving technical problems and obtaining technical effects to become the object of protection of the Chinese patent system.

Patent Protection for AI Technology Innovation in Food Safety Supervision

In the era of Industry 4.0, jobs with high repetition rates and heavy labour are gradually being replaced by AI. Similarly, in food safety supervision, AI can use its unique analytical and computational capabilities and autonomous learning ability to reduce the consumption of human and material resources and improve the accuracy of food risk warnings, thus effectively reducing the occurrence of food safety problems. For example, AI can monitor whether the staff wears the required clothing, hats and masks in the back kitchen and whether creatures like rats are present. It can also mark the facilities, equipment and tools in the back kitchen and record their usage status, thus providing effective personnel and environmental management. In addition, AI can also be applied to food identification (Boushey et al., 2016), sensory evaluation (Garcia-Esteban et al., 2018), food development and other fields, which can better regulate the food

production process and improve the accuracy and coverage of supervision.

China has made the development of AI one of the elements of its national strategy. The "Development Plan for a New Generation of AI" and the "White Paper on AI Standardization" emphasize using AI to improve public safety and security capabilities.

AI Technology for Food Safety Supervision Is Based On Big Data and Cloud Computing

The development of AI is contingent upon three fundamental components: data, computing power, and algorithms.

When considering the realm of data, it becomes evident that AI necessitates the utilization of big data technology as a foundational pillar of support. The fundamental technological framework underpinning contemporary AI is deep learning, a subfield of machine learning. Concurrently, the proliferation of big data technology has facilitated the exponential growth of network data resources, thereby furnishing a copious corpus of sample data for training AI systems through deep learning methodologies. Simultaneously, it is worth noting that AI frequently engages in substantial data storage and computation during its training phase, wherein sample data is utilized. This, in turn, necessitates the reliance upon big data technology to facilitate the abovementioned processes.

In computational capabilities, cloud computing is paramount in furnishing said capabilities. Implementing deep learning techniques in artificial intelligence necessitates the utilization of sophisticated foundational frameworks, accompanied by expeditious processors, cutting-edge graphics processing units (GPUs), and substantial quantities of memory and storage capacity. However, it is important to note that this augmented demand for system resources may occasionally result in temporary limitations on available resources. Using cloud computing in the context of AI training platforms is conducive to enhancing operational efficacy through its inherent computational capabilities. Furthermore, it is worth noting that cloud computing can offer both storage and computing services in the realm of big data technologies.

Therefore, big data and cloud computing are the foundation of AI technology, and these three are showing a trend of convergence, thus improving the learning efficiency, data computing efficiency and data analysis efficiency of AI. As mentioned above, there are still many problems with patent protection for big data and cloud computing, and only by solving and coping with these problems can the patent protection of AI technology be better realized.

Controversy over the Patentability of AI Technology for Food Safety Supervision

In addition to data and computing power, the key elements of AI include algorithms. As the underlying logic of AI, algorithms are the direct means of generating AI, and thus the core innovation of AI lies in improving algorithms. For example, the computational logic of ChatGPT comes from the transformer algorithm in the paper "Attention Is All You Need".

Under the Chinese Patent Law's provisions, it is true that "rules and methods of intellectual activity" are explicitly excluded from the realm of patentable subject matter. However, it is imperative to discern that AI algorithms do not fall within the purview of said rules and methods of intellectual activity. AI algorithms can concretely characterize human thinking activities, which can be abstract thinking, such as pure mathematical formulas, or they can be closely integrated with natural laws and technical problems, such as face recognition technology that pure mathematical formulas cannot represent. For the former case, if the AI algorithm is not linked to the laws of nature, it falls into the category of abstract thinking that is not protected by patent law. In the latter case, patents may be granted if the AI algorithm applies the laws of nature and can be combined with machinery and equipment to produce technical effects.

The issuance of the 2014 Interim Guidance on Subject Matter Eligibility for Patents by the USPTO signifies a significant development in patent law. This guidance addresses the situation wherein a patent application encompasses concepts such as "laws of nature, natural imagery, and abstract ideas." In such cases, it becomes imperative to ascertain the presence of "additional elements" to establish the applicant's eligibility for patent protection. The "additional elements" encompass enhanced applications in various technological domains or technical disciplines, applications tailored to a particular machine apparatus, or advancements in the internal operational efficacy of a computer system, among other possibilities (Qi & Cheng, 2015). The EPO recognizes schemes containing non-technical features (e.g. algorithms) and technical features as patentable subject matter (Zhao & Zhou, 2017). The State Intellectual Property Office of China has also set a set of criteria for patentable subject matter for AI algorithms. These criteria are as follows: firstly, the algorithm must be applied within a technical domain and yield a solution derived from the said

algorithm. Secondly, the solution derived from the algorithm must utilize technical means and effectively address technical issues within the given technical domain, thereby yielding corresponding technical effects. This information can be found in Decision No. 49914 of the Patent Re-examination Committee of the State Intellectual Property Office.

Therefore, the application of AI algorithms to specific technical fields is an important prerequisite for their patent protection. Of course, limiting an algorithm to a specific application area will limit the protection scope of its patent rights. This requires innovators to think deeply about applying the algorithm to multiple technical scenarios to obtain the widest possible scope of protection.

Response Strategies and Suggestions

At the Level of Legislation, the Examination Criteria for Food Safety Patent Applications Involving Algorithms Should Be Improved

Integrating technologies such as big data, cloud computing, and AI has become increasingly pervasive across various sectors of the economy and society. Consequently, the distinction between technical and non-technical domains, as well as the distinction between technical and non-technical aspects, has become increasingly ambiguous. These blurred boundaries have given rise to numerous controversies in patent application assessments, particularly concerning algorithms as the primary locus of innovation. This requires improving the examination standards and adapting to the development needs.

In terms of patentability review, an invention related to an algorithm should be included in the scope of patentable subject matter if it meets two conditions: (1) The algorithm has a specific and clear technical application area, such as technical processing of technical data such as speech recognition and image recognition per the laws of nature, improving data storage efficiency, reducing the amount of computation and system resource consumption, etc.; (2) Algorithms are subject to technical conditions, i.e., they are not purely numerical calculations, are related to specific physical quantities, and are capable of producing practical technical effects by combining specific physical quantities.

Concerning the examination of inventiveness, the Chinese patent examination rules take the "person of ordinary skill in the art" as the reference system for judging inventiveness to avoid the influence of subjective factors of the examiner as far as possible. However, the algorithm itself belongs to the computer field and has a specific application field, making the field to which the "person of ordinary skill in the art" belongs ambiguous. Currently, Chinese examiners focus on the field of technology indicated by the applicant in the patent application specification (Zhang, 2020), but it is debatable whether this practice is reasonable. At the same time, the inventiveness judgment should also consider the "impact of the application field on the technical solution and technical effect" as a factor. In other words, whether it is obvious to apply similar algorithms to different application areas, it is necessary to consider the algorithms' characteristics and the specificity of the application areas themselves to make the inventiveness judgment more objective and more in line with the innovation characteristics of different industries.

At the Level of Government, the Training of Inter-Disciplinary Patent Examiners Involved in Food Safety Supervision Should Be Strengthened

The cross-border nature of big data, cloud computing and AI has caused the cross-domain nature of the technical solutions of patent applications, which has invariably broadened the scope of the "technical field". It makes the inventiveness review work more demanding regarding the amount of relevant knowledge and more complex in the review process. This need is particularly acute in examining food safety technology patent applications. However, under the established system, patent examiners often only have knowledge and competence in a certain technical field, creating a contradiction between examination demand and capacity, resulting in longer examination cycles.

To this end, relevant government departments should strengthen the training of examiners, improve the technical literacy of examiners in relevant fields, increase the breadth and depth of examiners' participation in technical research, and optimise the matching of examiners' examination fields with patent applications.

In addition, a two-person review approach could also be considered, with one examiner belonging to the field of big data, cloud computing, or AI technologies and another examiner belonging to specific application areas of these technologies, resulting in a more objective and expedited examination.

At the Level of Innovators, Innovation in Food Safety Supervision Algorithms Should Be Enhanced, and the Misuse of Algorithms Should Be Limited

Algorithms are central to applying big data, cloud computing and AI technologies to food safety

supervision work. Data from different aspects of food supervision require corresponding methods for analysis and are applied with different boundary conditions. Instead of simply transplanting existing mature algorithms directly into food safety work, algorithms should be designed, optimized and modified according to the specific rules of the food industry to build an analytical model suitable for the actual needs of food safety supervision. Many algorithmic innovations may arise in this process.

It should be noted that algorithmic innovation cannot be misused. The collection and analysis of data by algorithms are likely to violate the privacy of the public, and even if this data is anonymised, it is difficult to control the leakage of private information. For example, Netflix made publicly available about 100 million anonymously processed movie ratings in 2006, but researchers can still identify specific users by analyzing this anonymous data against publicly available IMDB data (Tencent Research Institute, 2017). The SKYNET project developed by the US National Security Agency has access to information such as signal source, movement trajectory, call recipients and duration of 55 million cell phone users in Pakistan (Robbins, 2016). Food is important in defining an individual's identity, social status and culture. In accordance with the profound words articulated by the French lawyer Anthelme Brillat-Savarin in 1826, it is posited that the disclosure of one's dietary preferences and consumption patterns shall serve as a reliable indicator of their inherent character and disposition. It is imperative to establish an all-encompassing privacy protection policy that expressly forbids the utilisation of algorithms to infringe upon the privacy of individual citizens, all while purportedly safeguarding the domain of food safety.

Conclusion and Outlook

World economic development and the evolution of the international pattern are at a critical period. The technological revolution and industrial changes have provided more opportunities for countries to achieve leapfrog development and brought new situations, problems and challenges to the food safety supervision work of countries around the world. The patent system should protect and stimulate representative and forward-looking innovations in big data, cloud computing and AI in food safety supervision digital technology, which cannot be achieved without the cooperation and joint efforts of the legislature, government departments and innovators. China has already explored whether China should adopt the "long-arm jurisdiction" principle for foreign patent infringement in the Securities Law and the "Ruixing counterfeiting case".

It cannot be ignored that, like many high-tech tools, big data, cloud computing and AI are double-edged swords, bringing many challenges to human institutions, ethics, law, public opinion, social governance, etc. Digital technology has expanded the scope of information, accelerated the speed of information transfer and sharing, and led to concerns about protecting personal privacy and trade secrets. National security and civil rights are not dichotomous. Food safety, an indispensable component of national security, serves as a safeguard for preserving civil liberties and freedoms. Consequently, it becomes imperative to foster the dynamic ingenuity of digital technology to effectively address the pragmatic difficulties associated with the supervision of food safety. It is also imperative to meticulously maintain equilibrium between the prospective worth of data and the entitlements of individuals while refraining from the misuse of governmental authority to infringe upon civil liberties, notably the inalienable right to privacy, under the guise of safeguarding food security. It is posited that the progressive advancement of digital technology holds the potential to furnish a formidable shield safeguarding the realm of food safety.

References

Boushey, C. J., Spoden, M., Zhu, F. M., Delp, E. J., & Kerr, D. A. (2016). New mobile methods for dietary assessment: review of image-assisted and image-based dietary assessment methods. *Proceedings of the Nutrition Society*, *76*(03), 283-294. https://doi.org/10.1017/s0029665116002913

Bouzembrak, Y., & Marvin, H. J. P. (2016). Prediction of food fraud type using data from Rapid Alert System for Food and Feed (RASFF) and Bayesian network modelling. *Food Control*, *61*, 180-187. https://doi.org/10.1016/j.foodcont.2015.09.026

Garcia-Esteban, J. A., Curto, B., Moreno, V., Gonzalez-Martin, I., Revilla, I., & Vivar-Quintana, A. (2018). A digitalization strategy for quality control in food industry based on Artificial Intelligence techniques. *2018 IEEE 16th International Conference on Industrial Informatics (INDIN)*. https://doi.org/10.1109/indin.2018.8471994

Langmead, B., & Nellore, A. (2018). Cloud computing for genomic data analysis and collaboration. *Nature Reviews Genetics*, *19*(4), 208-219. https://doi.org/10.1038/nrg.2017.113

Lokers, R., Knapen, R., Janssen, S., van Randen, Y., & Jansen, J. (2016). Analysis of Big Data technologies for use in agro-environmental science. *Environmental Modelling & Software*, *84*, 494-504. https://doi.org/10.1016/j.envsoft.2016.07.017

Piao, J. (2011). Research on the Problems of China's Computer Software Patent Protection System. *Electronics Intellectual Property*, *8*, 92-94.

Qi, A., & Cheng, G. (2015). Determining Patent Suitability of 'Method Patents' in the Data Technology Era: A Review of the USPTO's 2014 Interim Guidelines on Patent Subject Matter Suitability. *Social Sciences in Hunan*, *3*, 60-64.

Robbins, M. (2016, February 18). Has a rampaging AI algorithm really killed thousands in Pakistan? *Inkl*. https://www.inkl.com/news/has-a-rampaging-ai-algorithm-really-killed-thousands-in-pakistan

Tencent Research Institute. (2017). *Artificial Intelligence: The grip of national AI strategic action*. China Renmin University Press.

van Asselt, E. D., Noordam, M. Y., Pikkemaat, M. G., & Dorgelo, F. O. (2018). Risk-based monitoring of chemical substances in food: Prioritization by decision trees. *Food Control*, *93*, 112-120. https://doi.org/10.1016/j.foodcont.2018.06.001

Wang, P., Wang, Z., & Ma, Q. (2019). Research on the Association of Mobile Social Network Users Privacy Information Based on Big Data Analysis. *Journal of Information Hiding and Privacy Protection*, *1*(1), 35-42. https://doi.org/10.32604/jihpp.2019.05942

Yao, M., Ling, Y., Xing, X., Yao, G., Liu, H., & Zhang, F. (2021). Comparative Study on Response Mechanisms to Food Safety Emergencies. *Journal of Food Safety & Quality*, *12*(10), 4221-4229.

Zhang, Y. (2020). On the Legal Standard of Patentability of Artificial Intelligence Inventions. *Studies in Law and Business*, *6*, 181-192.

Zhao, C., & Zhou, S. (2017). EPO Review of Patentability in the Computer Field. *China Invention & Patent*, *5*, 100-105.

Zong, X., & Wang, Y. (2017). The Implications of the Open FDA Data Policy in the United States for Food and Drug Regulatory Data Management in China. *Chinese Pharmaceutical Affairs*, *31*(9), 976-979.