Analysis of China's Internet of Things Patents Based on Cloud Computing

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Abstract. With the continuous development and progress of information technology, the Internet of Things has been practically used in many areas of people's lives. The Internet of Things technology, as a collection of connected things, has storage and computing capabilities, which greatly meets the needs of society and people. Cloud computing is an important foundation for the long-term exhibition of the Internet of Things technology. It combines the products of parallel distributed computing technology, network storage virtualization technology, load balancing traditional computer network technology and other technologies, and its computing method is a comprehensive computing the way. This article is based on China's cloud computing IoT patent application data as the analysis object. It conducts qualitative and quantitative analysis on patent-related trends, related technology composition, and applicant rankings. It reflects the current status of the development of IoT technology and is beneficial to domestic R & D institutions in the field of networking find research blind spots and choose appropriate research directions on their own.

Keywords: Cloud Computing, Internet of Things, Patent Analysis

1. Introduction

The technological revolution leads us into the information age, accelerating the overall development of human society[1]. Human society has gradually entered a new era of globalization and intelligence. The Internet of things, with the strong support of high-end technology and equipment, enables information exchange and communication between items, which has a great expansion and extension in all aspects of functions, and provides convenient services for people's lives through data exchange and sharing. At the same time, cloud computing plays an important role in the Internet of things, and its R & amp; D is gradually infiltrating all aspects of human living standards. As a perfect information management system, cloud computing can promote efficient use of resources, utilization and management, and has strong storage capacity and computing capacity.

At present, the transformation of China's economic development has become a very critical turning point. The development of information technology has gradually developed to a new stage of all-round, multi-functional and efficient. The integrative development of the Internet of Things and cloud
computing is inevitably facing difficulties such as the definition of industry categories, core technology breakthroughs, application promotion and scale, privacy protection technologies, and so on. As the country with the fastest economic development, the Internet of Things technology has become the focus of research[2]. The European Union published related reports on Internet of Things technology in 2009. Some countries are studying and developing more areas of Internet of things technology application at the technical level through the development and expansion of infrastructure. In 2004, Japan and South Korea took Internet of things technology as the key planning content of national scientific research and development.

Based on this, this article discusses the cloud computing Internet of Things patent data, and puts forward corresponding insights and reflections.

2. Analysis of technology integration of Internet of things and cloud computing

With the rapid development of the Internet of Things, the Internet of Things technology is constantly pursuing innovation for data processing and exchange operations[3]. The combination of cloud computing and the Internet of Things can effectively ensure computing and storage capabilities. The organic combination of cloud computing and the Internet of Things is divided into three important stages: the first stage is to use information and data as production factors to improve the industrial efficiency of enterprises; the second stage has changed the traditional production and management methods by improving the structural system; The third stage promotes the optimization of the overall industrial structure through information fusion[4].

The first stage
Cloud computing has strong data storage and computing capabilities, through which users can get more invisible knowledge, more detailed data information greatly improve the production efficiency, and then meet more needs of users. Internet of things technology combined with cloud computing technology can enable information and data to be managed centrally, and use detailed data analysis to adjust the system to achieve the purpose of low cost and high efficiency[5].

The second stage
The foundation of this stage makes how to use and manage to achieve the purpose of optimizing the production mode. The organic combination of cloud computing and the Internet of Things promotes more convenient remote scheduling and automatic monitoring goals. Automatic monitoring and remote scheduling have been implemented to achieve automated and centralized production[6]. The cloud computing intelligent information platform can achieve precise management modes and reduce human error.

The third stage
The main task of this stage is to upgrade the internal structure of the enterprise and realize the combination of service mode and application field. Cloud computing technology can build a collaborative platform to assist production mode, gradually develop and promote new technology, achieve cross industry information integration, and create new value[7].

3. Patent analysis of Internet of things under cloud computing

3.1. Data source

In this paper, incopat patent retrieval system is used as a platform for patent retrieval[8]. Incopat, as one of the largest patent databases in the world, contains more than 100 million basic patent data in a complete way. It processes the patent data of dozens of countries in the world with special processing. The data reliability is high, which guarantees the accuracy and reliability of the analysis results. The retrieval formula used in this paper is (AD=[20100101 to 20191231]) AND (TI= or or TI AB= wireless sensor or TI= simultaneous interpreting code or TI= (TI=), radio frequency identification (RFID), (Internet of things)) sensor (sensor), or (heterogeneous network fusion), heterogeneous network convergence, multi attribute decision making, cooperative transmission of the two channels, and control of the transmission of the current. =Mobility management or Tiab =
automatic PCI configuration or Tiab = mobile load balancing or Tiab = random access channel or Tiab = return technology or Tiab = heterogeneous network collaboration) and (full = (Internet of things) or full = (wireless sensor) or full = (wireless network)) or (Ti = (Internet of things and security) or Ti = (Internet of things and key) or Ti = (Internet of things and digital signature) or Ti = (Internet of things and recognition) Certificate) or Ti = (Internet of things and fault tolerance) or Ti = (Internet of things and Privacy) or Ti = (Internet of things and anonymity) or Ti = (Internet of things and signature) or Ti = (sensor and security) or Ti = (sensor and key) or Ti = (sensor and encryption)) and (Ti = cloud data or Ti = cloud computing or Ti = cloud software or Ti = cloud network or Ti = cloud application or Ti = cloud storage or Ti = cloud structure or Ti = cloud management or Ti = Cloud manufacturing or Ti = cloud security or Ti = cloud platform or Ti = cloud terminal or Ti = cloud server or Ti = cloud facility or Ti = public cloud or Ti = private cloud or Ti = IAAs or Ti = PAAS or Ti = SaaS). Through retrieval and secondary screening, 324 pieces of Internet of things technology patent data under cloud computing were obtained, with the retrieval date of December 24, 2019.

3.2. Application trend analysis

As can be seen from Figure 1, the number of IoT patent applications for cloud computing before 2009 was basically absent, starting to appear in 2010-2014, but most of them were less than 20. The number of patent applications increased significantly from 2015 to 2019, reaching 75 in 2015. From a trend perspective, the number of patent applications for the Internet of Things under cloud computing is still slowly falling in recent years, reflecting the characteristics of cloud computing technology in the technological development period.

3.3. Composition of patented technology
It can be seen from the above that the number of H04L (in the transmission of digital information, such as telegraph communication) is the largest in China's cloud computing IoT patents, with 152 applications, followed by G05B (general control or regulation system; functional units of this system); Monitoring or testing devices for such systems or units) 61, G06Q (data processing systems or methods specifically for administrative, commercial, financial, management, supervisory or forecasting purposes; other categories not specifically applicable to 53 systems for administrative, commercial, financial, management, supervisory or forecasting purposes).

3.4. Applicant ranking

![Number of patents](image)

**Figure 3. Applicant Ranking**

Figure 3 shows the ranking of important applicants for cloud computing IoT technology in China. Tianjin Huafang Technology Co., Ltd., Wang Xiangwei, Xidian University, Chongqing Fengchuang Technology Co., Ltd., and South China University of Technology are major applicants in this field.

3.5. Regional distribution of patents

| Province            | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---------------------|------|------|------|------|------|------|------|------|------|
| Jiangsu             | 0    | 3    | 4    | 2    | 8    | 15   | 5    | 3    | 4    |
| Guangdong           | 0    | 0    | 0    | 0    | 2    | 9    | 12   | 8    | 5    |
| Tianjin             | 0    | 0    | 0    | 0    | 13   | 5    | 2    | 6    |      |
| Anhui               | 0    | 0    | 0    | 0    | 10   | 10   | 14   |      |      |
| Zhejiang            | 0    | 0    | 2    | 0    | 3    | 4    | 2    | 8    | 5    |
| Beijing             | 0    | 0    | 0    | 1    | 2    | 2    | 8    | 2    | 7    |
| Shandong            | 0    | 2    | 2    | 3    | 4    | 4    | 5    | 2    | 0    |
| Sichuan             | 0    | 0    | 2    | 0    | 2    | 1    | 13   | 1    |      |
| Shaanxi             | 0    | 0    | 1    | 0    | 1    | 5    | 1    | 6    | 3    |
| Chongqing           | 0    | 0    | 0    | 0    | 1    | 2    | 1    | 0    |      |

Table 1 shows the distribution of IoT technology provinces and cities under cloud computing in China in the past ten years. The top ten are Jiangsu, Guangdong, Tianjin, Anhui, Zhejiang, Beijing, Shandong, Sichuan, and Shanxi. Province, Chongqing Province. It can be seen that most provinces and cities have a large number of patents in 2017 and 2018.

Table 1. Application trend of provinces and cities
4. Conclusion
This article uses the incoPat patent database to conduct an overall analysis of technology-related patents in China's Internet of Things field under cloud computing, and analyzes the development trend, regional distribution, key patent technologies, and application trends of cloud computing\textsuperscript{[9]}. It can be seen that China's IoT patents under cloud computing are growing and are in a period of development, and the domestic IoT technology is currently in a rapid development stage. There are many companies involved in research and development. Based on this, both cloud computing and IoT organic integration can be described as an inevitable development trend\textsuperscript{[10]}. All enterprises actively carry out research and development from the perspective of actual market demand, and actively promote the development of key technologies for the Internet of Things, which has made China a breakthrough in the development of new technologies.

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