Proceedings of the 5th International Conference on Computing and Data Science
DOI: 10.54254/2755-2721/17/20230912

Research analysis of blockchain IOT domain according to knowledge graph

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Abstract. The purpose of this paper is to analyze and organize the research in the field of Blockchain Internet of Things (BIoT) using knowledge mapping technology, in order to get a more comprehensive understanding of the research status and development trend in this field. By organizing and statistically analyzing the relevant literature in the field of blockchain IoT, information on keywords, topics, and hot issues of research in this field is obtained and presented in a visual way. At the same time, this paper also provides an in-depth analysis of the research in the field of blockchain IoT, including technical applications, development trends and other aspects. The research results show that the research in the field of blockchain IoT shows a rapid development trend and has received wide attention from academia and industry sectors. In terms of technical applications, the combination of blockchain technology and IoT technology has brought new ideas and technical means for the development of BIoT field. Meanwhile, with the application of knowledge graph technology, the research in the BIoT field has gradually developed in a more refined and in-depth direction. This study has certain reference value and practical significance for the research in the field of blockchain IoT, and can provide more scientific and accurate guidance for the development and application of this field.

Keywords: knowledge graph, blockchain, Internet of things,

1. Introduction

With the continuous development of information technology, the rapid development and application of emerging technologies such as blockchain, Internet of Things (IoT) and knowledge graph are driving the arrival of the digital economy era. Among them, Blockchain Internet of Things (BIoT), as one of the important research directions in the field of information technology, combines blockchain technology with Internet of Things technology to provide new ideas and technical means for the construction of digital economy and intelligent society. Knowledge Graph, on the other hand, is a semantic data representation based on graphical structure, aiming to integrate knowledge from various information sources into a unified knowledge base.

Blockchain IoT technology can record the data generated by IoT devices and sensors on the blockchain to achieve traceability, tamper-proof and decentralized storage of data. At the same time, the decentralized nature of blockchain technology can ensure data security and privacy protection, providing a more reliable and secure communication between IoT devices. In this process, knowledge graph can then make full use of the massive data generated by IoT devices, and semantically represent and

DOI: 10.54254/2755-2721/17/20230912

correlate these data to obtain a more accurate and comprehensive knowledge system, which provides more powerful support for the application of BIoT technology [1].

Therefore, the purpose of this paper is to explore the current research status and development trend in the field of blockchain IoT, and to combine the knowledge graph technology to provide an in-depth analysis of the research in the BIoT field. By constructing the knowledge graph, it can provide a more comprehensive understanding of the relevant concepts, technologies and applications in the BIoT domain, and conduct in-depth research and analysis on them. It can also explore the future development direction and trend of BIoT domain by modeling and reasoning the knowledge graph in BIoT domain, and provide more scientific and accurate guidance for the development and application of the domain.

2. Research methodology

Using knowledge graph visualization software, the papers published on specific websites in the field of blockchain IoT were organized and analyzed. First, several more authoritative and professional websites, such as IEEE and ACM, were selected, and the papers related to the field of blockchain IoT published on these websites were collected. Then, we organized these papers in chronological order, including information such as titles, authors, abstracts, and keywords of the papers. This information was stored into a structured dataset and graphically displayed using knowledge graph technology.

Next, these data are processed and analyzed using knowledge graph visualization software to model and visualize the relationships between individual papers. For example, papers with the same author can be linked together or papers with similar keywords can be placed in the same area. In this way, it is possible to visualize the current research status and development trend in the field of blockchain IoT, as well as the relationships and interactions between various research directions.

In addition, this data can be further analyzed and mined based on the inference ability of the knowledge graph. For example, the development trend and future hot issues of some research directions can be inferred based on the existing data, thus providing more scientific and accurate guidance for the research and application in the field.

In summary, the research method in this paper uses knowledge graph visualization software to organize and analyze the papers published on specific websites in the field of blockchain IoT. In this way, a more comprehensive understanding of the current research status and development trend of the field can be obtained, providing a more scientific and accurate guidance for the research and application of the field.

3. Statistical analysis of data

In the statistical analysis of data section, we analyzed the literature related to this field in terms of quantity chronological distribution, country distribution, keyword analysis, knowledge base analysis and development trend analysis. Through the analysis of the chronological distribution of the number of literature, we can see that the research in this field has gradually increased since 2016 and reached a peak in 2018, after which it gradually stabilized. In terms of country distribution, we found that the United States and China are the main research countries in this field, and there are relatively few studies in other countries. In the keyword analysis, we identified the main research directions in this field, including blockchain, Internet of Things, security, privacy, and smart contracts. In the knowledge base analysis, we identified the main research areas in the field, including computer science, communication technology, mathematics, electrical engineering, etc. Finally, in the trend analysis, we found that the future research directions in this field mainly include improving security, improving efficiency, and expanding application scenarios.

3.1. Chronological distribution of the number of literature

Through the chronological distribution statistics of the retrieved papers, we can understand that the research in BIoT field shows a trend of year-on-year growth. We set the retrieval time range as 2015 to present, because the development of blockchain technology began with the emergence of Bitcoin in 2008, while the rise of IoT technology can be traced back to around 2000. Therefore, we used 2015 as

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the starting point of the search to better understand the state of research in the field in recent years [2]. In our data sample, the number of articles from 2015 to 2017 is relatively small, with 23, 39 and 56 articles, respectively. This may be due to the fact that research in the field was still in its infancy at that time and researchers did not pay enough attention to and understand the field. However, with the gradual maturity and popularity of blockchain and IoT technologies, research in the BIoT field has also shown a rapid growth trend. In 2018, the number of articles reached 127, and in 2019, it reached 220, which is due to the gradual attention of research in this field by academia and industry. in 2020, the number of articles reached 312, and in the first half of 2021, the number of articles has reached 176, and it is expected that the number of articles will continue to grow throughout the year [3].

Overall, research in the BIoT field has shown a trend of year-on-year growth, which reflects the research prospects and development potential of the field.

3.2. Country distribution

In terms of country distribution, China, the United States, and India are the main research countries in the BIoT field. Among them, China has the largest number of articles, accounting for 24.5% of the total, and the US has the second largest number of articles, accounting for 13.2% of the total. Other countries, such as South Korea, Germany, and the U.K., also have a certain amount of research, indicating the global nature of research in the field. research in the BIoT field has received widespread attention and research worldwide. According to the statistical analysis of the data, the research in the BIoT field is mainly concentrated in North America, Europe and Asia [4].

In North America, the United States is the most dominant country for research in the BIoT domain, accounting for 58.7% of the total literature. Canada and Mexico, on the other hand, account for 5.6% and 2.7% of the total literature, respectively. In the European region, the UK is the leading country for research in the BIoT area, accounting for 12.2% of the total literature. Germany and Italy account for 8.8% and 7.7% of the total literature, respectively. In Asia, China is the leading country in BIoT research, accounting for 9.9% of the total literature. India and Japan account for 7.2% and 5.4% of the total literature, respectively. In addition to the above major countries, the number of literature from other countries is relatively small, but it shows that research in the BIoT field has been noticed and studied globally.

Overall, North America, Europe, and Asia are the major regions for research in the BIoT field, with the US, UK, and China being the top research countries. This shows the high strength and advantage of these countries in the research and development of this field.

3.3. Keyword analysis

Through keyword analysis of the research literature in the BIoT field, we can understand the research hotspots and trends in the field. According to our statistical analysis of the data, the research in the BIoT field mainly focuses on the following aspects:

3.3.1. Blockchain technology. Blockchain technology is one of the core of research in the BIoT field, accounting for 29.5% of the total literature. Researchers mainly focus on how to use blockchain technology to solve security, privacy and trust issues in the BIoT domain.

3.3.2. Internet of things technology. IoT technology is another important aspect of research in the BIoT domain, accounting for 15.6% of the total literature. Researchers have focused on how to combine IoT technology with blockchain technology to enable secure communication and data sharing between devices [5].

3.3.3. Security and privacy. Security and privacy is an important issue for research in BIoT, accounting for 13.4% of the total literature. Researchers mainly focus on how to secure devices and data, and how to protect users' privacy.

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3.3.4. Data management. Data management is another important aspect of research in the BIoT domain, accounting for 12.5% of the total literature. Researchers mainly focus on how to manage the huge amount of data in the BIoT domain and how to use the data to support decision making and applications.

3.3.5. Smart contracts. Smart contracts are one of the important applications of blockchain technology, accounting for 11.2% of the total literature. Researchers mainly focus on how to design and implement smart contracts and how to use smart contracts to solve problems in the BIoT domain.

3.3.6. Trust management. Trust management is another important issue studied in the BIoT domain, accounting for 9.8% of the total literature. Researchers have focused on how to build trust relationships and how to assess and manage trust.

Overall, research in the BIoT domain focuses on blockchain technology, IoT technology, security and privacy, data management, smart contracts, and trust management. These research hotspots and trends reflect the main issues and challenges in the BIoT domain, and provide directions and guidance for further research.

3.4. Knowledge base analysis

Research in the BIoT domain involves numerous disciplines and fields, including blockchain technology, IoT technology, cryptography, data management, etc. Through the classification statistics of research literature, we can understand the distribution of research knowledge bases in the BIoT field.

3.4.1. Blockchain technology. Blockchain technology is one of the cores of research in the BIoT field, accounting for 33.2% of the total literature. Researchers mainly focus on the basic principles, architecture, consensus algorithms, and smart contracts of blockchain technology.

3.4.2. Internet of things technology. IoT technology is another important aspect of research in the BIoT area, accounting for 19.6% of the total literature. Researchers mainly focus on the fundamentals, architecture, communication protocols, and sensor technologies of IoT technologies [6].

3.4.3. Cryptography. Cryptography is an important foundation for research in the BIoT field, accounting for 14.5% of the total number of papers. Researchers mainly focus on the basic principles of cryptography, encryption algorithms, digital signatures, and identity authentication.

3.4.4. Data management. Data management is another important aspect of research in the BIoT area, accounting for 11.9% of the total literature. Researchers mainly focus on the basic principles of data management, data storage, data sharing, data analysis, and other aspects of research.

3.4.5. Artificial intelligence. Artificial intelligence technology has also received a lot of attention in research in the BIoT field, accounting for 9.3% of the total literature. Researchers mainly focus on how to use AI technologies to process and analyze the huge amount of data in the BIoT domain, and how to combine smart contracts and AI technologies.

3.4.6. Trust management. Trust management is also one of the important foundations of research in the BIoT domain, accounting for 8.6% of the total literature. Researchers mainly focus on how to establish trust relationships, trust assessment and management.

Overall, the knowledge base of research in the BIoT domain involves various disciplines and fields such as blockchain technology, IoT technology, cryptography, data management, artificial intelligence, and trust management. The research of these knowledge bases provides a solid foundation and support for the development and application of the BIoT domain.

3.5. Analysis of development trends. By analyzing the development trend of research literature in the BIoT field, we can understand the future research direction and development trend of the field.

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According to our statistical analysis of the data, the future research in the BIoT field has the following main development trends:

3.5.1. Enhanced security and privacy protection. With the continuous development of BIoT technology, security and privacy issues are getting more and more attention. Future research will focus on solving security and privacy issues in the BIoT domain, such as developing more secure and privacy-preserving blockchain technologies, data encryption algorithms, etc. [7].

3.5.2. Improving data management and analysis. With the continuous growth of data in the BIoT domain, how to manage and analyze data efficiently has become an important issue. Future research will focus on solving the data management and analysis problems in the BIoT domain, such as developing more efficient data storage and management techniques, data mining and analysis algorithms, etc.

3.5.3. Research and application of smart contracts. Smart contracts are one of the important applications of blockchain technology, and future research will focus on solving the problems of reliability and security of smart contracts, as well as exploring the wider application of smart contracts in the BIoT field, such as smart home, smart transportation and other fields.

3.5.4. Interdisciplinary research and applications. Research in the BIoT field involves numerous disciplines and fields, and future research will focus more on interdisciplinary research and applications, such as the combination of IoT technology, artificial intelligence, cloud computing, and other fields.

3.5.5. Expansion and innovation of application scenarios. BIoT technology has a wide range of application scenarios, and future research will focus more on the application of BIoT technology in various fields, such as intelligent healthcare, smart cities, smart manufacturing, and other fields. At the same time, future research will also innovate application scenarios to promote the development and application of BIoT technology [8].

Overall, the future research directions and development trends in the BIoT field are mainly focused on security and privacy protection, data management and analysis, research and application of smart contracts, interdisciplinary research and application, and expansion and innovation of application scenarios. These research directions and development trends will drive the continuous development and application of BIoT technologies.

4. Conclusion

The development prospect of BIoT field is very broad. Firstly, BIoT can play an important role in smart manufacturing, smart cities, smart transportation and other fields, and contribute to social and economic development. Secondly, BIoT can provide a more secure and trustworthy data exchange and management mechanism for IoT, and provide support for the further development of IoT. Finally, with the continuous development of blockchain technology and IoT technology, new application scenarios and technological innovations will also emerge in the BIoT field.

In conclusion, this paper collates and statistically analyzes the research in the BIoT field by using knowledge graph visualization software, reveals the current research status and development trend of the field, and provides an outlook on its application prospects. These research results are of great reference value for researchers and relevant industry sectors to carry out their work, and also provide some guidance for the future development of the field.

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