

# Application of Data Visualization Technology Under the Background of Big Data

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*Abstract:* - In the development trend of big data era, visualization technology gradually integrates with big data technology to form data visualization technology. This paper mainly introduces the concept of data visualization, analyzes and summarizes the advantages of data visualization technology, and analyzes its application scenarios, such as financial, E-commerce, medical, education, agriculture, weather forecast, transportation and epidemic prevention fields. Finally, through the above application scenarios, we can better understand the importance of data visualization technology in the big data environment.

*Key-Words:* - Data Visualization Technology; Big Data; Financial.

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## 1 Introduction

In the era of big data, not only are all kinds of data flooding our lives, but also we need to process and use all kinds of data [1-3]. We can not do without data, can not do without all kinds of information, in receiving information at the same time we are also the sender of information. The massive and complicated data usually makes people dazzled. How to get the data we need quickly and accurately has become a big problem that modern big data technology is committed to solving. Nowadays, data capture technology based on web crawler technology has been applied in many aspects, which greatly improves the efficiency of data acquisition. However, not everyone is skilled in working with data, and for data that is difficult for non-professionals to understand and difficult for professionals to understand, it needs to be presented in another way. Data visualization technology allows data to be presented in the form of pictures, charts and so on, intuitively and effectively conveying the information expressed by data to people [4]. In general, data visualization technology

helps us to better manage and understand data and get more useful information from it. And with the continuous maturity of data visualization technology, it is applied in more and more fields and scenes, bringing more and more services, playing a more and more important role.

With the development of big data, the value of data is released to the maximum extent. Small data may carry important information under certain circumstances, so even small data may have an unimaginable important role. When it comes to big data, the first thing that comes to mind should be its "many". Indeed, big data is characterized by large amount of data, various types of data, fast transmission speed, high time-efficiency, low value density and online data [5]. In addition, compared with traditional data, the "data online" feature of big data allows people to search and call data for unlimited time and realize real-time data sharing. Data visualization is an indispensable tool for big data analysis. Data visualization technology is a kind of technology that uses programming and coding to transform all kinds of numbers and letters

representing data into graphics and other visual objects for people to view intuitively. In fact, data visualization is more like a way of communication, receives the information from the data source, and its visualization, to want to get the data of a more intuitive, clear get want to get the information, and that for the message, let the information fast, and easy to understand is to receive is desired.

Data visualization requires the construction of data space, the use of a variety of data sets to form a multidimensional space, but also need to calculate and analyze the data, multidimensional data also need to analyze the data from multiple angles, every step should be accurate and accurate. Data visualization is not a single technical method, it includes many technical methods, because the principle of visualization is more than one, with the development of technology, data visualization has been put forward a variety of methods [6].

From the concept of data visualization, we can know that data visualization is a more advanced and simple technology compared with traditional visualization. Clarity and intuition are the most essential characteristics of data visualization. Using data visualization to sort out and analyze data will greatly improve work efficiency. Traditional data visualization, such as various statistical graphs and tables such as histograms, scatter graphs and broken line graphs, are often used for data analysis in real life [7]. However, compared with advanced data visualization developed in the era of big data, traditional data visualization is less efficient and more complicated. In the era of big data, data visualization should not be limited to static charts and graphs, but more used data visualization should be interactive and interactive. Compared with static expression, dynamic expression can deepen people's impression, and people can receive the information conveyed by complex data more easily, which is clearer and more intuitive. Therefore, dynamic data visualization is more interactive and more efficient than traditional data visualization.

Therefore, in the era of big data, data visualization is evolving all the time. People's definition and concept of it are constantly changing with the development of big data technology and the evolution of The Times, and its boundaries are constantly expanding.

## **2 Overview of Big Data and data visualization technology**

Big data refers to the collection of data that cannot be captured, managed and processed by conventional software tools within a certain period of time [8]. It is a massive, high-growth and diversified information asset that requires a new processing mode to have stronger decision-making ability, insight and discovery ability, and process optimization ability. Big data covers a wide range of industries, including politics, education, media, medicine, commerce, industry, agriculture, Internet and other aspects in addition to finance.

According to the report of McKinsey, an internationally renowned consulting company, information technology, financial insurance, government and wholesale trade have the highest potential in terms of the comprehensive value potential of big data application [9]. In terms of the data volume of each company in the industry, the data volume of information, finance and insurance, computer and electronic equipment, and public utilities is the largest. It can be seen that both the information industry and the financial industry are key industries for big data application in terms of investment scale and application potential. If we look into its development history, data visualization has previously gone through two stages: scientific visualization and information visualization. Different from the previous two stages, the definition of data visualization at this stage is broader, which comes from the increase of its technical methods. Not only computer technology, image processing, mathematical modeling and so on are applied to data visualization, and the combination of various technologies gives rise to its

broader concept. This becomes a major prerequisite for the flexible application of data visualization technology in various fields.

With the development of data visualization, there are more and more data visualization technologies in front-end interface, such as Highcharts, Echarts, Charts, D3, etc. Most of them can be flexibly used in PC and mobile devices, and have high compatibility, allowing them to be used in many browsers. Some of them are open source, but not entirely free, and require licensing and paying fees to get better services [10]. Some are open source and free with rich features; Some visualizations take on a variety of forms; Some can be used flexibly and quickly without any plug-in. In general, they are highly compatible and easy to operate and use. In addition, in the process of continuous development, these technologies will be more perfect, with more new features, new functions, while the user experience will be constantly improved, the user will be more and more.

In addition to front-end technology, data visualization technology also has a relatively representative graphics technology -- Processing, which is an open source programming language based on Java development. Compared to front-end technology, Processing is also a development environment. As a development environment, it not only supports Linux, Windows, and Mac OSX platforms, but also supports exporting images to various formats. Therefore, Processing has higher compatibility and flexibility.

The data visualization market has grown since the concept of data visualization was first recognized [11]. There are endless visualization products in the data visualization market at home and abroad, and there are many mature products. The representative ones known to people are DateV, RayData, Tableau, Sugar, etc.

In the era of big data, visualization technology has occupied a place and developed into an irreplaceable part. No matter how visualization

technology develops and how numerous visualization products are, in terms of development concept, it has been continuously developing to provide convenience and better service to people's life.

### **3 Application of data visualization technology**

With the continuous development of data visualization technology and tools, more and more technologies and tools have been developed and applied, which also makes data visualization applied in more and more industries. In the process of the continuous development and application of artificial intelligence technology, the two technologies are gradually combined and applied, so that more and more fields are gradually becoming intelligent. Here are the main applications of data visualization:

#### **3.1 Financial and E-commerce fields**

In the era of big data, information is advanced, digital economy is developing rapidly, a large amount of data is generated in the financial field, and data visualization has been widely applied in the financial field [12]. By using data capture technology, financial information can be captured quickly on the Internet, such as valuable information related to customers in various transactions, and the obtained data can be analyzed and mined. Using visualization technology intuitive multi-angle analysis of customer behavior effectively, so as to get the real needs of customers, understand customer profitability of financial products, security, and so on various aspects of demand, further through the technology of data for the design of financial products to build, in the form of visual, eventually make reasonable design scheme, Design financial products that meet customer expectations.

In addition, based on the technology of data, managers can obtain the whole financial market transaction data, and carries on the full data from multiple perspectives analysis and calculation, intuitive use data visualization technology to show

the stages of financial market development trend, then can design better and more reasonable for the next step of financial products to provide direction and train of thought. Big data technology brings not only the improvement of financial analysis tools to the financial industry, but also stimulates new changes in financial technology in the process of continuous development. The integration of big data technology and financial technology enables the massive and miscellaneous data generated by the financial industry to be filtered and purified, which further improves financial efficiency and enables financial technology to be innovated. For financial services, data visualization has completely changed the traditional financial services, enabling them to realize the innovation of financial services based on big data. With the help of data visualization technology, user data can be intuitively analyzed and modeled from multiple angles. The data can be classified and sorted according to the needs of managers, and user needs can be reasonably divided, so as to provide targeted financial services to users. Based on the "data online" feature of big data, even if the decision is wrong, it can find out the mistake and correct it in time. In general, the application of data visualization in the financial field will promote the improvement and innovation of all aspects of the financial industry, not only enhance the activity of the financial market, but also increase the competitiveness of the industry and enable it to get more development.

With the rapid development of the Internet, the e-commerce industry has risen rapidly and developed in full swing [13]. Therefore, when people make use of various e-commerce platforms for online shopping, massive e-commerce data will be generated, and the demand for data management will increase. The use of big data technology to manage data, hot-selling commodity analysis, service data analysis, customer feedback analysis, logistics information management, to make more scientific and reasonable strategies, in order to achieve precision marketing, personalized

recommendation, personalized service and other applications, improve competitiveness, optimize the quality of the industry.

### **3.2 Medical and education fields**

Compared to the early medical industry to record and store data in written form, data visualization brings electronic data storage, which greatly reduces the risk of data loss [14]. At present, the medical industry can predict influenza, conduct genome analysis, patient data analysis and other medical data analysis through big data visualization technology. Remote monitoring of equipment and evidence-based medicine are also the applications of data visualization in the medical industry. These applications can help patients achieve intelligent management of disease. Through real-time data sharing, medical information sharing can be realized by constructing data network between medical staff and patients, and management information system between medical devices. The application of data visualization plays a key role in the realization of smart medical treatment and the construction of a new green medical ecology.

The application of data visualization in the field of education means that data visualization enters the classroom and the concept of smart classroom will be deepened [15-17]. In the era of big data, creating smart classrooms in the field of education has become a development trend. Knowledge is no longer limited to books, videos, etc. More and more dynamic forms make knowledge more intuitive and dynamic display, which can not only deepen the reconstruction of knowledge, but also promote the training of learning thinking. In intelligent teaching, massive learning data will be optimized to make it multi-dimensional and multi-structured. The application of learning process analysis, knowledge heavy and difficult analysis, teacher-student information sharing, and future performance prediction can realize the sharing of information between teachers and students and between students, and realize the goal

of knowledge visualization, thinking visualization, learning data visualization, so as to create a more interactive classroom experience.

### **3.3 Agriculture and weather forecast fields**

In agriculture, data visualization also has many application scenarios [18]. By analyzing the data of crop growth environment, growth preference, growth cycle and so on, using data visualization technology to simulate the growth and development of crops in specific light, water, temperature, humidity and other conditions, to achieve the determination of the best growth conditions of crops. And using big data technology, the simulation experiment can be carried out quickly only by importing relevant data. Compared with experiments under natural conditions, big data simulation experiments are more efficient, and the results obtained under natural conditions are just as accurate and real. The agricultural simulation experiment completed by data visualization can not only greatly save the experiment time, reduce the input of manpower, material resources and financial resources, but also ensure the purpose of agricultural teaching experiment. In addition, the traditional agricultural field teaching is based on field practice, the use of data visualization can be agricultural teaching visualization, through the computer network and other remote visual teaching, interactive experience as if immersive.

In the field of weather forecast, daily weather forecast work also produces a large number of data [19]. With the help of big data technology, various meteorological observation data and geographical observation data can be managed, and the data visualization method can be used to present the analysis results more intuitively and effectively, so as to obtain scientific and reasonable decisions, which is conducive to better developing various meteorological services. For example, Tableau is an intelligent software with simple operation and flexible use. As a visualization tool, it can quickly switch and generate views by following the path of

thinking. Some studies have used it for statistical analysis of meteorological data, and conducted in-depth group analysis through dynamic screening of data visualization, and obtained the results of research without the aid of visual tools in previous years very quickly [20].

### **3.4 Transportation and epidemic prevention fields**

With the improvement of economic level, people's living standard has also been improved [21]. In order to meet the demand of going out, more and more families have private cars, and traffic congestion has become a concern. The application of data visualization in the field of traffic provides a new way to solve the problem of traffic congestion. With the support of transportation Internet of Things and CIS and other technologies, it collects all kinds of transportation infrastructure information, constructs the transportation system more intuitively and effectively, and actively seeks solutions. The construction of three-dimensional space transportation network, convenient staff to find information, repair loopholes, greatly improve work efficiency. Using data visualization technology to solve the problem of traffic congestion is scientific and effective, and Shenzhen is a successful case. Looking to the future, data visualization will be applied in a wider range in the field of traffic.

Data visualization also plays an important role in epidemic prevention [22-24]. Not only the epidemic situation in different regions and the whole country, but also the situation of the global epidemic. Through data visualization, the map of the global epidemic situation can be built to analyze the flow of people and exit and entry conditions, so as to make more scientific and reasonable decisions on epidemic prevention and control. A series of applications such as real-time observation, real-time reporting, real-time monitoring and real-time protection have made important contributions to

improving the epidemic situation and implementing epidemic prevention and control [25].

Nowadays, we are increasingly inseparable from big data, and while recognizing the importance of big data technology, how to avoid the possible risks of big data technology is also worth thinking about [26]. Although the development potential of big data technology is huge, it does not mean that it will not have negative effects that disturb people. In fact, in the era of big data, our personal privacy has been seriously disclosed. Whether we can use big data technology to solve the problems caused by big data needs to be explored. While enjoying the benefits brought by the development of science and technology, we also need to be alert to danger in times of peace and have an optimistic attitude.

#### 4 Conclusion

In the era of big data, data visualization technology plays an important role in many fields, such as financial, E-commerce, medical, education, agriculture, weather forecast, transportation and epidemic prevention fields. Finally, through the above application scenarios, we can better understand the importance of data visualization technology in the big data environment.

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#### References:

- [1] Jiang H, Wang K, Wang Y, et al. Energy big data: A survey[J]. *IEEE Access*, 2016, 4: 3844-3861.
- [2] Rathore, M. Mazhar, et al. "Urban planning and building smart cities based on the internet of things using big data analytics." *Computer networks* 101 (2016): 63-80.
- [3] Kitchin, Rob. "The real-time city? Big data and smart urbanism." *GeoJournal* 79.1 (2014): 1-14.
- [4] Roth, Steven F., et al. "Interactive graphic design using automatic presentation knowledge." *Proceedings of the SIGCHI conference on Human factors in computing systems*. 1994.
- [5] Zhang, Hao, et al. "In-memory big data management and processing: A survey." *IEEE Transactions on Knowledge and Data Engineering* 27.7 (2015): 1920-1948.
- [6] Olshannikova, Ekaterina, et al. "Visualizing Big Data with augmented and virtual reality: challenges and research agenda." *Journal of Big Data* 2.1 (2015): 1-27.
- [7] Olshannikova, Ekaterina, et al. "Visualizing Big Data with augmented and virtual reality: challenges and research agenda." *Journal of Big Data* 2.1 (2015): 1-27.
- [8] Kaisler, Stephen, et al. "Big data: Issues and challenges moving forward." *2013 46th Hawaii international conference on system sciences*. IEEE, 2013.
- [9] Nicoletti, Bernardo, Weis Nicoletti, and Weis. *Future of FinTech*. Basingstoke, UK: Palgrave Macmillan, 2017.
- [10] Li, Deqing, et al. "ECharts: a declarative framework for rapid construction of web-based visualization." *Visual Informatics* 2.2 (2018): 136-146.
- [11] Sander, Thomas, et al. "DataWarrior: an open-source program for chemistry aware data visualization and analysis." *Journal of chemical information and modeling* 55.2 (2015): 460-473.
- [12] Suryono, Ryan Randy, Indra Budi, and Betty Purwandari. "Challenges and trends of financial

- technology (Fintech): a systematic literature review." *Information* 11.12 (2020): 590.
- [13] Zhu, Zijiang, et al. "Quality of e-commerce agricultural products and the safety of the ecological environment of the origin based on 5G Internet of Things technology." *Environmental Technology & Innovation* 22 (2021): 101462.
- [14] Rodrigues, Joel JPC, Orlando RE Pereira, and Paulo ACS Neves. "Biofeedback data visualization for body sensor networks." *Journal of Network and Computer Applications* 34.1 (2011): 151-158.
- [15] Teizer, Jochen, Tao Cheng, and Yihai Fang. "Location tracking and data visualization technology to advance construction ironworkers' education and training in safety and productivity." *Automation in Construction* 35 (2013): 53-68.
- [16] Peck, Evan M., Sofia E. Ayuso, and Omar El-Etr. "Data is personal: Attitudes and perceptions of data visualization in rural pennsylvania." *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. 2019.
- [17] Keefe, Daniel F., and David H. Laidlaw. "Virtual reality data visualization for team-based STEAM education: Tools, methods, and lessons learned." *International Conference on Virtual, Augmented and Mixed Reality*. Springer, Berlin, Heidelberg, 2013.
- [18] Archontoulis, Sotirios V., and Fernando E. Miguez. "Nonlinear regression models and applications in agricultural research." *Agronomy Journal* 107.2 (2015): 786-798.
- [19] Bendre, M. R., R. C. Thool, and V. R. Thool. "Big data in precision agriculture: Weather forecasting for future farming." 2015 1st International Conference on Next Generation Computing Technologies (NGCT). IEEE, 2015.
- [20] Rajeswari, S., K. Suthendran, and K. Rajakumar. "A smart agricultural model by integrating IoT, mobile and cloud-based big data analytics." 2017 international conference on intelligent computing and control (I2C2). IEEE, 2017.
- [21] Badarinath, K. V. S., Shailesh Kumar Kharol, and Anu Rani Sharma. "Long-range transport of aerosols from agriculture crop residue burning in Indo-Gangetic Plains—a study using LIDAR, ground measurements and satellite data." *Journal of Atmospheric and Solar-Terrestrial Physics* 71.1 (2009): 112-120.
- [22] Gao, Kai, Yan-Ping Song, and Anna Song. "Exploring active ingredients and function mechanisms of Ephedra-bitter almond for prevention and treatment of Corona virus disease 2019 (COVID-19) based on network pharmacology." *BioData mining* 13.1 (2020): 1-20.
- [23] Jia, Qiong, et al. "Big data analytics in the fight against major public health incidents (Including COVID-19): a conceptual framework." *International journal of environmental research and public health* 17.17 (2020): 6161.
- [24] Mbunge, Elliot, et al. "A critical review of emerging technologies for tackling COVID - 19 pandemic." *Human behavior and emerging technologies* 3.1 (2021): 25-39.
- [25] Gardy, Jennifer L., and Nicholas J. Loman. "Towards a genomics-informed, real-time, global pathogen surveillance system." *Nature Reviews Genetics* 19.1 (2018): 9-20.
- [26] Song, Haiyan, and Han Liu. "Predicting tourist demand using big data." *Analytics in smart tourism design*. Springer, Cham, 2017. 13-29.

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