Influence and Application of Big Data Analysis in Product Design Research

Fan Yang

1Dalian University of Science and Technology, Liaoning, Dalian, China, 116001

*Corresponding author e-mail: relayoung515@dlut.edu.cn

Abstract. Design research is an important work in product design. Through a series of data collection and data analysis, we can better adjust the design scheme. The traditional product design research mode data analysis effect is not good, through the Big Data(BD) technology research and analysis of product design, is a good solution at present. Therefore, this paper establishes the research on the influence and application of BD analysis in product design research. In this paper, the product design research and the application of BD analysis technology in the design research are deeply studied and analyzed. It is believed that through the BD technology, the research content can be analyzed more scientifically, so as to improve the overall product design effect. In order to make the BD analysis technology better applied in product design research, this paper optimizes and improves the evaluation crowd weight calculation method of entropy processing, which effectively improves the accuracy of the algorithm. In order to further verify the application effect of BD analysis in product design research; this paper establishes a test experiment with "mobile power supply" as the product. The experimental results show that among the tested users, young people aged 15-20 are the main ones, accounting for 38.7%. According to the analysis of users' interests and hobbies, the highest proportion of digital options is 31.2%. The analysis shows that the results of BD analysis provide valuable reference for the formulation and adjustment of product design strategy.

Keywords: BD Analysis, Data Mining, Product Design Research, Market Research

1. Introduction

BD is a broad concept. Its core competence is to discover rules and predict the future. It is possible to use BD technology to scientifically predict individual future behavior and some social events. However, BD's prediction of the future is not 100%, which precisely reflects the scientificity and accuracy of BD [1-3]. Whether the fuzzy data can be obtained will become an important ability of product design research in the future. Fuzzy data can indicate the direction of product design, clear the results of data integration, and predict the future development trend, so that enterprises have a more clear strategy for the evaluation of profits and the future trend of products [4-5].

Different dimensions and BD formats are different. These data fragments can be text, pictures, videos, etc., but there are data conflicts and errors in these large amounts of related data. More
accurate data needs to be obtained through preprocessing [6-7]. Through cross link analysis of
different dimensions of data, we can verify each other and compare their authenticity. In the era of BD,
through cloud computing on the Internet, we can analyze and compare these data in the early stage of
product design research, cross verify the logical relationship between data, and improve the fault
tolerance of survey data [8-10].

This paper deeply studies the current application of BD analysis technology in product design
research in China, and understands that there are still many problems in the application of BD analysis
technology in the existing product design research, including unreasonable research methods,
insufficient data collection samples, and backward algorithm. However, at the same time, many
intelligent and efficient BD research and analysis platforms have emerged in China, which has helped
the research work of product design. According to the application of existing BD in product design
research, this paper puts forward the influence and Application Research of BD analysis in product
design research, hoping to further optimize the mode of BD product design research and improve the
effectiveness of research work. According to the actual needs of product design research, this paper
optimizes and improves the existing evaluation crowd weight calculation method of BD entropy
processing, and the improved algorithm is more suitable for the field of product design research. In
this paper, the impact of BD analysis technology on product design research is deeply analyzed, and
the data collection and data analysis are described. Combined with the current application of product
design research and BD analysis technology, this paper analyzes that the application of BD analysis
technology can play a continuous optimization role in product design research, and has a positive role
in improving data collection, data analysis, and strategy adjustment.

2. Product Design Research and BD Analysis Technology

2.1. Brief Introduction of Design Investigation
Design research is an important part of design discovery. Different from other professional surveys,
design research is a series of targeted research activities to collect and analyze data from the
perspective of designers. Design research emphasizes the designer's ability of observation and
comprehensive analysis. Through the collection and analysis of data, the design scheme to meet the
needs of users is found. According to the different sources of research data, design research can be
divided into secondary study and preliminary study. The primary research is to sort out and summarize
the existing information related to the problem, which can be collected through books and the Internet.
Secondary research runs through the whole process of design, which is of great help to design
creativity.

2.2. Significance of Data Analysis
The so-called "extensive data" of modern life, which is also the depth of people's life, is increasing. As
a new "lens", BD is influencing the way people look at the world. BD is a set of comprehensive data
generated by human behavior. In front of massive data, the correctness of a certain data does not affect
the final analysis results. "Small data" emphasizes causal analysis; the purpose is to find out the cause
of the problem. "BD" emphasizes correlation analysis, the purpose of which is to analyze massive data,
find out the relationship between target problems and related problems, and predict according to these
relationships. Therefore, as designers, we only need to know "what" from the data. Through the
correlation analysis of BD, designers can improve the discovery of user requirements.

2.3. Weight Calculation of Evaluation Population Based on Entropy Processing
According to the property of entropy, the entropy weight coefficient of evaluation population is
determined. According to the entropy processing of the matrix, the state probability of the evaluation
system acting on each evaluation index is as follows:
The evaluation information entropy of the evaluation population is as follows:

\[ E_t = -\frac{1}{\ln(5)} \sum_{j=1}^{t} P_j \ln(P_j) \]  

(2)

Where, \( t = 1 \sim 5 \), and specify \( P_j = 0 \), \( P_j \ln P_j = 0 \) at that time. Because of \( 0 \leq P_j \leq 1 \), we can get \( 0 \leq E_t \leq 1 \).

The deviation \( d_t \) is defined as:

\[ d_t = 1 - E_t \]  

(3)

According to the entropy weight calculation formula, the weight of each evaluation group can be calculated:

\[ v_t = d_t \sum_{j=1}^{5} d_j \]  

(4)

3. Preliminary Application of BD Platform in Product Design Research: Taking "Ali index" as an Example

In the era of BD explosion, in order to meet the challenges, we need a platform to show the value of data. Such as Baidu Index and other BD platforms have been born, and promote the development of different industries. Taking "Ali index" as an example, this paper analyzes the application of BD platform in product design research. "Ali index" mainly uses the massive BD generated by all online and offline products in Alibaba Group ecosystem for data analysis. "Ali index" is to analyze index data from the perspective of region and industry. "Industry index" mainly refers to the analysis of the development status of commodity trading and the characteristics of consumer groups from the perspective of industry. "Regional index" mainly refers to the analysis of the development of all kinds of transactions, trade exchanges, and the basic situation of commodities and the characteristics of consumer groups from the perspective of region. Through the above two indexes, we can understand the consumer characteristics of each commodity transaction category.

In this paper, mobile power supply as the product of this test, through the mobile power supply set "mini, convenient, compact, large capacity, original" five characteristic keywords, its BD analysis and investigation. The survey is mainly conducted with the help of BD platform, in which the combined keywords of "mobile power" and "mobile power mini" are input in turn, and the main attributes of users are statistically analyzed through the analysis of BD platform.

4. Discussion

4.1. Test Results and Analysis

According to the experimental method described above, the results of each group of keywords in Ali index were statistically analyzed. This time, a total of 89524 pieces of information are displayed. Through the data analysis function of the BD platform, the user characteristics are classified. The search data given by the BD platform get the results in Table 1, Figure 1 and Figure 2.

According to the statistical results of Table 1, Figure 1 and Figure 2, young people aged between 15 and 20 years accounted for 38.7%, followed by 21-30 years old, accounting for 29.6%. In terms of user constellation statistics, Gemini accounted for 26.2% of users, followed by Taurus, accounting for 16.9%.

Figure 2 shows the survey and analysis of users' hobbies. The analysis further investigates users' interests and hobbies, which is helpful for designers in product design and can better grasp the demand points of target users. The results show that digital (a) accounts for 31.2%, music (b) accounts for 22.4%, and game (c) accounts for 15.1%. Facts show that these three functions are also the main uses of mobile phones and other digital products. The remaining sports (d), reading (E), storage (f),
and other (g) accounted for 9.8%, 8.9%, 7.4% and 5.2% respectively. The analysis shows that through BD analysis, we can quickly understand and master the demand characteristics of target users, which plays a good role in the design of designers’ products and the satisfaction of users’ needs.

Table 1. proportion of user constellation.

| Constellation | Proportion (%) | Constellation | Proportion (%) | Constellation | Proportion (%) |
|---------------|---------------|---------------|---------------|---------------|---------------|
| Taurus        | 16.9          | Lion          | 8.5           | Scales        | 11.5          |
| Scorpio       | 6.7           | Capricorn     | 4.7           | Pisces        | 2.1           |
| Shooter       | 3.8           | White sheep   | 4.5           | Virgin        | 6.5           |
| Gemini        | 26.2          | Level         | 2.3           | Cancer        | 6.3           |

Figure 1. Analysis of survey results of users' age groups

Figure 2. Analysis of survey results of users' interests and hobbies

4.2. Impact of BD Analysis on Industrial Design Research

(1) Data collection
Compared with the traditional "purposeful" data acquisition method, BD acquisition is more "casual". For example, the type of data users browse, the allocation of time, and personal information disclosure are all part of BD. As you can see, users are generating data all the time. Therefore, the data in this stage are not focused on "collection", but more on "processing". However, simple data accumulation is not the essence of BD. All types of data need to "communicate with each other" to achieve the fundamental purpose of BD. Usually, different places have different consumer groups and different people have different consumption habits. Through such layer by layer analysis, we can get the correlation between data, which is the essence of BD.

(2) Data analysis
The data analysis method in the era of BD has developed from the traditional information query mode to the deep computer operation mode. In other words, the designer only needs to input the processed data into the designed system to obtain the corresponding analysis results. Such data collection and analysis methods have been widely used in e-commerce. Usually, the platform integrates a large number of databases, and users only need to select the analysis method required by the platform, and then they can get the visual results. The traditional survey system needs some basic knowledge of statistics. At present, most of the product designers come from art majors, so they don't have enough knowledge of statistics. Therefore, the separation of product design and existing human data analysis technology is not conducive to the future employment of students and the development of product industry. For product designers in this stage, we should develop a more humanized product research system as soon as possible.

4.3. BD Helps Design Continuous Optimization
Any product development to the final launch of the market does not mean that the entire design process has been completed; design is a process of continuous modification and improvement. Designers need to constantly track the market, study the response of different consumers to their product design, so as to optimize the design. Through the BD platform, the designer's follow-up tracking is easier to achieve. Designers can mine relevant data through BD platform. Through the evaluation of users, some valuable hidden needs are found, which can guide the product innovation and technological transformation. At the same time, BD can also avoid the potential risk of customer churn to ensure the continuous vitality of products.

5. Conclusions
Under the background of the rapid development of computer and intelligent technology, the data analysis ability of BD is particularly important. In recent years, BD analysis technology has been widely used in the field of product design. From the change of design concept to the research work of product design, BD technology is almost indispensable. Research on product design through BD technology can enrich data collection channels, and use the current advanced data analysis methods to effectively analyze the data, which provides constructive suggestions for the strategy adjustment of product design. The analysis shows that at present, the needs of users are developing towards diversification and personalization. Therefore, it is one of the basic abilities of future product designers to be able to skillfully use BD analysis methods. Only in this way can we better design products that meet the needs of users.

References
[1] Liu, Z., Wang, Y., Cai, L., Cheng, Q., & Zhang, H. (2016). Design and manufacturing model of customized hydrostatic bearing system based on cloud and BD technology. International Journal of Advanced Manufacturing Technology, 84(1-4), 261-273.
[2] Liu Weiwei. (2019). The integration trend and its characteristics of social physics and BD technology%. The integration trend and its characteristics of social physics and BD technology. Dialectics of Nature Communications, 041 (009), 80-86.
[3] Yu Wangchun. (2019). Research on the role of BD technology in the construction of university
library management system. Science and Technology Information Development and Economics, 004 (005), 16-19.

[4] Wu, J., Li, H., Cheng, S., & Lin, Z. (2016). The promising future of healthcare services: when BD analytics meets wearable technology. Information & Management, 53(8), 1020-1033.

[5] Cai, L., & Zhu, Y. (2015). The challenges of data quality and data quality assessment in the BD era. Data ence Journal, 14(1), 21-3.

[6] Xu, W., Zhou, H., Cheng, N., Lyu, F., Shi, W., & Chen, J., et al. (2018). Internet of vehicles in BD era. IEEE/CAA Journal of Automatica Sinica, 5(1), 19-35.

[7] Zou, Y., Peng, Y., Deng, L., & Jiang, T. (2015). Monitoring infectious diseases in the BD era. Science Bulletin, 60 (1), 144-145.

[8] Santos, O. C., & Boticario, J. G. (2015). User-centred design and educational data mining support during the recommendation’s elicitation process in social online learning environments. Expert Systems, 32(2), 293-311.

[9] Calvet Li?án, Laura, & Juan Pérez, ángel Alejandro. (2015). Educational data mining and learning analytics: differences, similarities, and time evolution. International Journal of Educational Technology in Higher Education, 12(3), 98-112.

[10] Zhang, M. (2017). Application of data mining technology in badminton spot tactical analysis system. Agro Food Industry Hi Tech, 28(1), 3398-3401.