Research Article

Analysis of the Influencing Factors of Urban Sports Brand Sales Volume Based on AHP

Mingyue Zhang,¹ Yuxin Wu,²,³ and Xiaolong Zhou ²,³

¹School of East Asia, Pai Chai University, Daejeon 35345, Republic of Korea
²Zhengzhou Vocational College of Finance and Taxation, Zhengzhou 450000, Henan, China
³Department of Leisure Services and Sports, Pai Chai University, Daejeon 35345, Republic of Korea

Correspondence should be addressed to Xiaolong Zhou; 2111818011@e.gzhu.edu.cn

Received 1 July 2022; Accepted 5 August 2022; Published 15 September 2022

Academic Editor: Hengchang Jing

Copyright © 2022 Mingyue Zhang et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

In order to evaluate the brand image and help enterprises to build an ideal brand image, the influence factors of urban sports brand sales volume based on AHP are studied. The article takes the A sports brand as the research object, selects six dimensions including product dimension, enterprise dimension, and service image dimension, establishes a brand image evaluation model, and uses the AHP to study the A sports brand image. The experimental results show that: it is found that the overall evaluation value of A sports brand image is 81.153 points, which is rated as very satisfactory, it is proven that the research gives relevant recommendations for maintaining and developing brand image.

1. Introduction

Archetypes are ubiquitous in many sports brand images, they more or less contain the shadow of some archetypes, and marketers may not realize this, but as soon as a brand enters the world of meaning, it will touch the archetype. In the image advertising of world-renowned sports brands, the image of the prototype generally exists. Although the research on consumer brand cognition based on the “cognition-attribute” research paradigm has achieved fruitful results, it still lacks a deep understanding of consumer brand cognition [1]. In the field of brand research, there are several special concepts, such as brand spirit, brand essential, brand soul, and brand resonance. From the perspective of analytical psychology, these concepts point to something similar at the bottom of the consumer psyche, which is related to the archetypes deep within us.

Brands, like where we work, study or the environment around us, have become an important part of our daily lives. In today’s age of brands, some super brands have become a symbol, and some brands are trying to become international brands recognized by consumers [2]. The prototype paradigm based on Jung’s prototype theory has received more and more attention from foreign brand marketing scholars. The rationale for incorporating archetype theory into global brand marketing is that brand archetypes reflect the way humans interpret their relationship to their lifestyle, combined with the bottom layer of consumer psychology, providing consumers with cross-cultural symbolism for identity construct. Therefore, brand marketers try to discover the “soul” of the brand, combine the basic psychological tendencies of consumers, and express it in a way that connects universal archetypes to create a truly global icon. Logo brands acquire symbolic meaning through association with archetypes, and consumers buy logo brands to acquire the symbolic meaning of mythological archetypes to construct the self, social, and cultural identities. Unique stories and myths infused or crafted around a product create consumer beliefs about the brand [3]. By associating the brand with the positive characteristics of an archetypal image, marketers integrate and disseminate the advertising marketing information chain with a specific archetypal trait, bringing a mysterious experience to consumers.
2. Literature Review

Seyyedamiri and Khosravaniproposed the five-star model of brand equity, that is, "five-star" consists of brand awareness, recognition, association, loyalty, and other unique assets, the theory believes that the purpose of brand communication is to accumulate brand equity [4]. Liu et al. put forward the theory of integrated marketing communication, which has far-reaching influence on communication and marketing so far. Its core idea is that when an enterprise conducts communication activities, all communication means should be unified and reorganized, but at the same time, consumers will get the same information no matter which channel they choose [5]. Cai and Wei proposed "global brand strategy" and many other theories have promoted the development of brand communication theory [6]. Yang et al. put forward the concept of brand ecology, thinking that the brand has the characteristics of life and exists in a complex environment, and its survival and development conform to the characteristics of ecological behavior [7]. Sui et al. put forward some innovative viewpoints, such as the choice of advertising communication is not the chaotic media, but the precise advertising carrier [8]. Lopez et al. believes that "brand communication is an activity to communicate with consumers through advertising, marketing activities, sales communication and other channels [9]. Yadav, proposed that the process of brand communication is the process of transmitting brand information to consumers. The concept of brand communication is defined as follows: the so-called brand communication, also known as brand image communication, is the process of transmitting the information contained in brand elements to consumers and the public through various communication channels or means of communication, only when consumers recognize, accept, consume and experience can a brand become a real brand. It will analyze the various elements of brand communication, and provide the basis for the shaping and communication of brand image [10]. Song et al. proposed that brand is a two-way value relationship, that is, there is a two-way value relationship between consumers, enterprises, and brands. In the book, he thought about the development of brand communication in the Internet era and also constructed a theoretical system of integrated brand communication from the perspective of value integration and proposed related models [11].

As a well-known local sporting goods company in China, A-Sports brand integrates honors such as “China Famous Brand,” “China Famous Brand Product,” “China Quality Inspection Free Product,” “China Top 500 Brand,” and its sales performance ranks among the top in the country, the comprehensive market share of sports shoes has ranked first among similar products in the country for many consecutive years and has a good reputation among. The author takes the sports brand of A sports brand as the research object and establishes a brand image evaluation model. By determining the six dimensions of the brand image, including product dimension, enterprise dimension, service image dimension, publicity image dimension, enterprise-customer relationship dimension, and brand symbol dimension, the brand image of A sports brand is evaluated, and relevant conclusions are drawn and the future brand is given, advice on image development.

3. Research Methods

3.1. Analysis of the Current Situation of a Sports Brand Sports Brand. The growth of A sports brand has gone through three stages: start-up, rapid growth, and brand promotion. The initial stage has completed the original accumulation, and the rapid growth stage mainly relies on advanced channel construction and advertising strategies. At present, the A sports brand is mainly in the stage of brand promotion. Under the attack of many sports brands at home and abroad, how to cultivate the brand of A sports brand and stand out is undoubtedly the primary task of the company [12]. According to the difference in market position and product substitution degree, the competitors of A Sports brand can be divided into direct competitors and industry competitors, direct competitors are competitors with similar positioning to A sports brand and strong product substitution; Industry competitors refer to competitors whose brand positioning is very different from that of A Sports and whose products are less substitutable. An analysis of the advantages and disadvantages of A sports brand and its main competitors is shown in Table 1.

3.2. Determination of A Sports Brand Image Evaluation Index. In the evaluation of the brand image, the factors that affect brand image are complicated, based on the Fan Xiucheng model and the characteristics of the sporting goods industry, the author proposes six evaluation dimensions: product dimension, enterprise dimension, service image dimension, publicity image dimension, enterprise-customer relationship dimension and symbol dimension [13]. On the basis of these six dimensions, it is subdivided into 30 factors such as product quality, style, and price (see Table 2). And, the Analytic Hierarchy Process (AHP method) is used to determine the weight of each element at each level and form the A sports brand image evaluation index system. Figure 1 is a tree structure diagram of the A sports brand image evaluation factor index system.

According to the brand image evaluation factor index system, it is determined that the target layer X layer is the comprehensive evaluation value of A sports brand image, X1, X2, X3,…, X63 is the product dimension, enterprise dimension, service image dimension and other six dimensions, X11, X12, X13,…, X63 are 30 evaluation factors such as product quality.

3.3. Determination of the Weight of Factors in the Brand Image Evaluation of a Sports Brands. In order to make the weight of the brand image evaluation factors better reflect the importance of each factor to the brand image, the author interviewed 2 scholars in brand management and 5 representative sales managers, marketing managers, and employees with at least 3 years of work experience in the sports product industry, on the importance of brand image evaluation factors at all levels to grade the degree, the scores are
Table 1: Analysis of the advantages and disadvantages of A sports brand and its main competitors.

| Type            | Brand | Advantage                                                                 | Disadvantage                                                                 |
|-----------------|-------|---------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| Direct competitor | B     | (1) Early start, mature management and operation level                    | (1) The product is not very professional, the positioning is not clear, it is both leisure and sports |
|                 |       | (2) large market share and high brand awareness                           | (2) The product name is easy to be regarded as gymnastics, and the consumer’s cognition is poor. |
|                 |       | (3) production has been outsourced, focusing on R&D and branding          | (3) The product concept “anything is possible” is similar to “impossible is nothing” of the D brand, but lacks features |
| Industry competitor | C, D, etc. | (1) industry leader, leading market share, high brand loyalty and reputation | (1) The disease of large enterprises, low management efficiency, lack of innovation and vitality |
|                 |       | (2) production outsourcing, strong R&D and marketing capabilities, strong financial strength, and advanced management level | (2) due to outsourced production of products, there are supply chain and product quality risks |
|                 |       | (3) Clear market and product positioning, pyramid-shaped scientific brand planning | (3) In the Chinese market, it is not acclimatized, and the channel strategy of its sales agents is an obstacle to its development |
|                 |       | (4) strong star endorsement lineup                                        |                                                                               |
| Research object | A     | (1) strong learning ability, independent research, and development ability is better than direct competitors | (1) in the low-end market, the bargaining power of products is low |
|                 |       | (2) Strong supply chain integration ability and R&D ability make the product cost lower and the quality better | (2) core competencies to be cultivated and developed |
|                 |       | (3) perfect production and sales system: with integrated construction from product design, production to terminal sales | (3) The brand lacks overall planning, and the brand awareness, loyalty, and reputation need to be further improved |

Table 2: Hierarchy structure of factors for brand image evaluation of A sports.

| Product dimension X1 | A comprehensive evaluation value of sports brand image X |
|----------------------|---------------------------------------------------------|
| X11                  | Product quality                                        |
| X12                  | Product style                                          |
| X13                  | Product material                                       |
| X14                  | Product price                                          |
| X15                  | Product color                                          |
| X16                  | Additional services (such as promotions, additional gifts, etc.) |
| X21                  | The company’s position in the market                    |
| X22                  | Knowledge of the business                              |
| X23                  | The stability of enterprise product quality             |
| X24                  | Enterprise innovation                                  |
| X25                  | The reliability of the products produced by the enterprise |
| X31                  | Store location                                         |
| X32                  | Store environment                                      |
| X33                  | The quality of service personnel                       |

| Enterprise dimension X2 | |
|-------------------------|-----------------------------|
| X34                     | Number of service staff     |
| X35                     | Service staff clothing      |
| X36                     | After-sales service         |
| X37                     | Ease of purchasing the product |
| X41                     | Discounts, giveaway promotions |
| X42                     | Membership card and VIP card system |
| X43                     | Impressed by the ad         |
| X44                     | Advertising spokesperson image |
| X45                     | Advertising slogan          |
| X51                     | The role of brands in life  |
| X52                     | The degree of impact after the brand is discontinued    |
| X53                     | Brand irreplaceability      |
| X54                     | The degree of conformity with the consumer’s personality and taste |
| X61                     | Brand name                 |

| Service image dimension X3 | |
|-----------------------------|-----------------------------|
| X62                     | Branded                     |
| X63                     | Logo                        |
weighted and averaged to obtain a judgment matrix, and the pairwise comparison software is further used to calculate the priority weights of factors at each level [14]. After calculation, the maximum eigenvalues of $A, A_1, A_2, A_3, A_4, A_5,$ and $A_6$ are 6.5446, 6.3079, 5.4273, 7.5475, 5.2587, 4.1384, and 3.0385, respectively. Random consistency ratio $C. R.$ are 0.0878, 0.0496, 0.0954, 0.0692, 0.0578, 0.0512, and 0.0333, respectively, which passed the consistency test.

Table 3 shows the weights of all factors at the three levels. Among them, among the secondary factors, the product dimension $X_1$ has the largest weight, which is 0.4586, indicating that the product has the greatest impact on the brand image of the A sports brand; The second is the dimension of publicity image, and the dimension of the enterprise-customer relationship, with weights of 0.2411 and 0.1295, respectively; compared with the other five dimensions, the symbol dimension is the smallest at 0.0291, indicating that the impact of symbols on the brand image of A sports brand is relatively small [15]. For the third-level factor, in the product dimension, the weight of product quality $X_{11}$ is the highest, which is 0.4121, followed by the price of the product; in the enterprise dimension, the position of the enterprise in the market contributes the most to it, with a contribution rate of 0.5183, followed by the reliability of the enterprise’s products and the stability of the enterprise’s product quality; in terms of service image, the largest weight of store environment is 0.3579, followed by the convenience of purchasing products and the location of the store; in the dimension of publicity image, the impression of advertisement has the largest weight, which is 0.5242, followed by membership card, VIP card system and advertising image spokesperson; in the dimension of enterprise-customer relationship, the largest contribution rate is 0.4937, followed by the role of the brand in life; in the dimension of brand symbol, the contribution rate is the brand name, brand packaging and brand logo [16].

3.4. Calculation of Fuzzy Evaluation of Brand Image of a Sports Brand. In the fuzzy evaluation calculation, the qualitative description of the quality of the evaluation object, the author uses four levels of evaluation to establish the evaluation vocabulary $V$: V1 (very satisfied) V2 (satisfied) V3 (general) V4 (dissatisfied).

![Figure 1: A tree structure diagram of sports brand image evaluation factor index system.](image_url)

| Index | Weight set |
|-------|------------|
| $X_1$ | $A_1 = [0.4586, 0.0882, 0.0535, 0.2411, 0.1295, 0.0291]$ |
| $X_2$ | $A_2 = [0.4121, 0.1279, 0.0485, 0.2863, 0.0321, 0.0931]$ |
| $X_3$ | $A_3 = [0.1613, 0.3579, 0.0964, 0.0228, 0.0296, 0.0560, 0.2760]$ |
| $X_4$ | $A_4 = [0.0672, 0.2475, 0.5242, 0.1224, 0.0387]$ |
| $X_5$ | $A_5 = [0.3072, 0.0887, 0.1104, 0.0493]$ |
| $X_6$ | $A_6 = [0.6370, 0.2583, 0.1047]$ |

The prior standard of satisfaction is $P$: $[100–90]$ (excellent), $[90–80]$ (good), $[80–70]$ (general), $[70–60]$ (pass), $[60–0]$ (no pass).

A matrix $R$ is established to perform single-factor evaluation on the subfactor layer. On this basis, according to the multiplication rule of fuzzy evaluation, the fuzzy evaluation matrix $E$ of the first-level index can be obtained as follows:

$$E = \begin{bmatrix} A_i \times R_i \\ \vdots \\ A_i \times R_{ni} \end{bmatrix} = \begin{bmatrix} 0.5195, 0.0388, 0.0326, 0.2991 \\ 0.5182, 0.0808, 0.3748, 0.0263 \\ 0.5031, 0.3202, 0.1461, 0.0306 \\ 0.5560, 0.3911, 0.0393, 0.0136 \\ 0.3316, 0.4000, 0.1657, 0.1027 \\ 0.5404, 0.0326, 0.4261, 0.0009 \end{bmatrix}.$$ (1)

Among them, $R_i$ is the fuzzy matrix of the secondary index, $A_i$ is the weight of the secondary index, and $i = 1, 2, 3, 4, 5, 6$.

Calculate the variance of the subindex layer and determine the weight of the index layer: $\hat{A} = [0.4586, 0.0882, 0.0535, 0.2411, 0.1295, 0.0291]$, then use the following formulas (2) and (3):

$$X = A \times E = [0.5035, 0.2527, 0.0994, 0.1444],$$ (2)

$$X' = [0.5035, 0.2527, 0.0994, 0.1444].$$ (3)

Then, the comprehensive evaluation result is the following formula (4):

$$Q = X' \times P = [0.5035, 0.2527, 0.0994, 0.1444] \times \begin{bmatrix} 90 \\ 80 \\ 70 \\ 60 \end{bmatrix} = 81.153.$$ (4)
The application of the evaluation model and the feedback on the evaluation results can be seen, A sports brand sports brand image evaluation index and actual evaluation results have a good consistency in connotation and extension, and each index is measurable, which basically reflects the scientificity and operability of brand image evaluation. The overall situation of A sports brand sports brand image evaluation is shown in Figure 2.

4. Analysis of Results

Through 30 factors of six dimensions, including product dimension, enterprise dimension, service image dimension, publicity image dimension, enterprise-customer relationship dimension, and brand symbol dimension, the brand image evaluation model of A sports brand is constructed, and the result of A sports brand sports is obtained, the evaluation results of the overall brand image and the evaluation results of the six dimensions [17].

From the overall results of the evaluation model, it can be seen that the total value of the sports brand image evaluation of A sports brand is 81.153 points, and the weight distribution of the comment grades is: very satisfied 0.5035, satisfied 0.2527, generally 0.0994, dissatisfied 0.1444, indicating that the A sports brand image is in the between excellent and good, the rating is very satisfied.

The weights of the six evaluation dimensions are product dimension (0.4586), publicity image dimension (0.2411), enterprise-customer relationship dimension (0.1295), enterprise dimension (0.0882), service image dimension (0.0535), brand symbol dimension (0.0291), the evaluation of each dimension is shown in Table 4. Except for the enterprise-customer relationship dimension, which is at the satisfaction level, the other five dimensions are at the very satisfactory level, indicating that the role of the enterprise in life and the degree of influence after production suspension are low, reflecting the high risk of brand replacement. In the dissatisfaction level, the product dimension ranks first, but the product dimension has the largest weight among all factors, it shows that consumers still hope that the A sports brand can guarantee the quality of products, further reduce prices and provide more complete additional services [18–24].
5. Conclusion

Compared with the international strong sports brand, the sports brand has a big gap in terms of the marketing concept, capital strength, technical ability, and management level. In order to adapt to the changing market competition environment, A sports brand still needs to practice internal strength, study consumer psychology and behavioral characteristics, cultivate its own long-term competitive advantage, especially establish a brand concept, and create a positive, clear, and unique in the minds of customers, brand image, maintain customer satisfaction and loyalty. The specific measures are as follows:

Establish a Scientific Brand Concept. A sports brand decision makers must have scientific brand awareness and attach great importance to the construction of their own brands; in the process of brand building, we must adhere to scientific decision-making and tactful choices, starting from the actual situation of the enterprise, while fully excavating the essence of national culture, we must absorb the design experience of Nike, Adidas, and other brands, carefully build brand image, reasonably choose brand promotion channels, and actively participate in international brand competition. Refine and Promote the Core Value of the Brand. The core value of the brand is the foundation of the A sports brand, the A sports brand is based on the middle and low-end market, the core value is “grass-roots culture,” which is different from Nike’s elite culture and Li Ning’s national culture and represents the value of the broadest class, culture is a kind of perseverance in the face of failure, hope to win respect and glory through unremitting struggle. Therefore, a series of activities such as VI design, celebrity endorsement, sponsorship, and public relations of A sports brand sports brand must focus on this core value and realize the concept of “keep moving.”

Increase Brand Recognition, Loyalty, and Reputation. High brand recognition requires A sports brand to fulfill basic commitments such as product quality, price, and appearance based on its high-quality and low-cost product positioning. Increase awareness through word-of-mouth communication and enhance the positive image of the A sports brand. High brand loyalty requires A sports brand to provide better products and services on the basis of fulfilling its basic commitments, and to maintain and manage the relationship with new and old customers. It can increase sales, reduce costs, and form competition barriers. High brand reputation, on the one hand, A sports brand should rely on marketing to provide customers with more transfer value and improve customer satisfaction.

Conflicts of Interest

The authors declare that there are no conflicts of interest.

References

[1] H. K. Leng, I. M. Rozmand, Y. H. Low, and Y. X. P. Phua, “Effect of social environment on brand recall in sports video games,” International Journal of Gaming and Computer-Mediated Simulations, vol. 13, no. 1, pp. 1–11, 2021.
[2] E. Mayes, J. P. Lineberger, M. Mayer, A. Sanborn, H. Smith, and E. Walker, “Automated brand color accuracy for realtime video,” SMPTE Motion Imaging Journal, vol. 130, no. 3, pp. 45–49, 2021.
[3] Y. N. Fan, W. Y. Wang, C. W. Kan et al., “Q-max test analysis of men’s quick-dry sportswear,” Materials Science Forum, vol. 1033, pp. 136–140, 2021.
[4] N. Seyyedamiri and A. Khosravani, “Identification of the effective e-promotional tools on improving destination brand image,” Journal of Global Information Management, vol. 28, no. 3, pp. 169–183, 2020.
[5] K. Liu, X. Li, Z. Zhu, L. Brand, and H. Wang, “Factor-bounded nonnegative matrix factorization,” ACM Transactions on Knowledge Discovery from Data, vol. 15, no. 6, pp. 1–18, 2021.
[6] W. Cai and Z. Wei, “Pūgān: generative adversarial networks for pluralistic image inpainting,” IEEE Access, vol. 8, no. 1, pp. 48451–48463, 2020.
[7] L. Yang, B. Li, W. Li, H. Brand, B. Jiang, and J. Xiao, “Concrete defects inspection and 3d mapping using cityflyer quadrotor robot,” IEEE/CAA Journal of Automatica Sinica, vol. 7, no. 4, pp. 991–1002, 2020.
[8] Y. Sui, G. Li, and J. Ge, “Sales associations between brand stores based on spatial interaction effects,” Mathematical Problems in Engineering, vol. 2021, no. 2-3, pp. 1–10, Article ID 9990947, 2021.
[9] R. Lopez, S. Larsson, and J. Silfwerbrand, “Discrete element modelling of rockfill railway embankments,” Granular Matter, vol. 23, no. 3, pp. 1–14, 2021.
[10] R. Yadav, “Analytic hierarchy process-technique for order preference by similarity to ideal solution: a multi criteria decision-making technique to select the best dental restorative composite materials,” Polymer Composites, vol. 42, no. 12, pp. 6867–6877, 2021.
[11] Z. Song, H. Gao, W. Liu, L. Li, W. Zhang, and D. Wang, “Systematic assessment of dredged sludge dewaterability improvement with different organic polymers based on analytic hierarchy process,” Journal of Environmental Sciences, vol. 103, pp. 311–321, 2021.
[12] J. Shin, I. You, and J. T. Seo, “Investment priority analysis of ics information security resources in smart mobile iot network environment using the analytic hierarchy process,” Mobile Information Systems, vol. 2020, no. 3, pp. 1–11, 2020.
[13] C. Wu, Y. Guo, and L. Su, “Risk assessment of geological disasters in ningchui, tibet,” Open Geosciences, vol. 13, no. 1, pp. 219–232, 2021.
[14] E. S. Ari and C. Gencer, “The use and comparison of a deterministic, a stochastic, and a hybrid multiple-criteria decision-making method for site selection of wind power plants: an application in Turkey,” Wind Engineering, vol. 44, no. 1, pp. 60–74, 2020.
[15] J. J. Zhao, R. N. Chen, J. H. Wang, and X. Y. You, “Multiple indicators and analytic hierarchy process (ahp) for comprehensive performance evaluation of exhaust hood,” Building Simulation, vol. 15, no. 6, pp. 1097–1110, 2022.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.
[16] B. R. Sahoo and S. K. Palei, "Erratum to: application of risk-based maintenance using analytic hierarchy process for selection of maintenance policy of dragline," Journal of Mining Science, vol. 56, no. 5, p. 877, 2021.

[17] M. Yucesan and M. Gul, "Failure modes and effects analysis based on neutrosophic analytic hierarchy process: method and application," Soft Computing, vol. 25, no. 16, pp. 11035–11052, 2021.

[18] A. A. Alfanatseh, G. K., and A. M. A., "Intermodulation of gut-lung axis microbiome and the implications of biotics to combat COVID-19," Journal of Biomolecular Structure & Dynamics, pp. 1–17, 2021.

[19] W. Li, G. Xu, D. Zuo, and J. Zhu, "Corporate social responsibility performance-evaluation based on analytic hierarchy process-fuzzy comprehensive evaluation model," Wireless Personal Communications, vol. 118, no. 4, pp. 2897–2919, 2021.

[20] A. Sharma, G. Rathee, R. Kumar et al., "A secure, energy- and sla-efficient (sese) e-healthcare framework for quickest data transmission using cyber-physical system," Sensors, vol. 19, no. 4, p. 2119, 2019.

[21] M. Bradha, N. Balakrishnan, S. Suvi et al., "Experimental, computational analysis of butein and lanceolrin for natural dye-sensitized solar cells and stabilizing efficiency by IoT," Environment, Development and Sustainability, Springer, Berlin, Germany, 2021.

[22] J. Hu, Y. M. Kang, Y. H. Chen, X. Liu, X. Li, and Q. Liu, "Analysis of aerosol optical depth variation characteristics for 10 years in urumqi based on MODIS_C006,” vol. 39, no. 8, pp. 3563–3570, 2018.

[23] R. Huang, Framework for a smart adult education environment, vol. 13, no. 4, pp. 637–641, 2015.

[24] Q. Zhang, "Relay vibration protection simulation experimental platform based on signal reconstruction of MATLAB software,” Nonlinear Engineering, vol. 10, no. 1, pp. 461–468, 2021.