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Research Article

Innovative Marketing Framework for Enterprises Using Edge-Enabled Data Analysis

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An effective marketing strategy has become a challenging task with the development of the social economy for the reform and innovation of many domestic and foreign enterprises. The idea of edge computing is also gaining prominence and is broadly recognized. Edge-enabled solutions provide computing, analysis, storage, and control nearer to the edge of the network. The existing literature highlights the concepts of social media marketing and evaluates the advantages of social media for communication between individuals and companies. However, there is a lack of an effective marketing strategy for enterprises. This article proposes an innovative marketing framework for enterprises using data analysis and wireless networks. The proposed framework is composed of two different modules. Initially, a corporate innovation and marketing framework module is established through edge computing to carry out a wireless transmission of relevant data and information at the edges of the network. Later, the enterprise marketing resource optimization module is constructed based on the particle swarm algorithm. The proposed framework performs efficient calculation and storage using a resource optimization module. The feasibility and effectiveness of the proposed framework are verified using the analysis of the actual case test results. This proposed framework can effectively improve the innovation efficiency level of existing enterprises and the optimization of marketing management resources.

1. Introduction

Entering the new era of social development, an effective marketing strategy has become a challenging task. The enterprises face development challenges to adapt to high-quality development and an ever-changing market economy. Enterprises should transform from manufacturing to brand development goals, actively promote industrial upgrading and transformation, and develop toward the goal of high quality, excellent structure, stable growth, and innovation [1–3]. This requires strengthening product quality and brand building projects. To comply with national policy requirements and adapt to the pressure of market competition, various enterprises have responded and deeply analyzed the current internal status of enterprises and the external business environment [4]. By organizing and participating in various development forums under the high-quality perspective, enterprises seek high-quality development strategies with product services, brand building, marketing strategies, organizational structures, and other factor-driven methods [5].

With the rise of wireless networks, the idea of edge computing is also gaining prominence and is broadly recognized. Edge-enabled solutions provide computing, analysis, storage, and control nearer to the edge of the network to resolve the issues of scalability and latency. Edge computing offloading technology uses computing-intensive and delay-sensitive computing that is difficult to handle by mobile devices. The migration of tasks to the servers surrounding the mobile device not only improves the processing capacity of the mobile device but also ensures the energy rate of the device. Since the implementation of the reform and opening policy, the social and economic construction has adhered to the principles of internal reform and opening to the outside world. It also adheres to the comprehensive deepening of reforms and adheres to the combination of importing and going out. While promoting the rapid development of the enterprise industry, it also forces the enterprises to adjust their development strategies in an all-round way to deal with the impact of globalization and to build a high-quality enterprise development layout with efficient brand marketing strategies [6, 7]. Marketing theory started relatively early abroad, and the theory is more advanced. In 1955, Levy and Gardner first proposed brand theory [8]. In 1956, American marketing master Philip Kotler created the famous STP analysis model [9]. The 4P marketing concept was put forward by E. Jerome McCarthy in 1960. This theoretical significance made the focus of brand marketing gradually shift from the product itself to the needs and desires of consumers [10]. H. Weihrich created the SWOT (strength, weakness, opportunity, and threats) model construction method to find the best marketing strategy through a comprehensive analysis of the company. Robert F. Lauterborn put forward the 4C marketing concept, an in-depth analysis of the brand's influence on winning consumers [11].

With the advent of the Internet era, new media has changed the way of brand development, network marketing has become a new form of sales, and related theoretical research has also been developed rapidly. Stuart Dillov conducted high-level research on brand building and brand communication and published "How to Create a Brand" to provide a reference for business management [5]. Duane. E. K proposed that the brand marketing strategy consists of five steps, namely, market research, brand reputation establishment, brand development planning, brand culture promotion, and product advantages [5]. Tybout. A. M's research concluded that a brand is an identification of products and services, and a brand can be associated with specific products and the unique value of the brand itself [12].

There are certain limitations in the use and practical application of data in the context of a wireless network. The existing literature highlights the concepts of social media marketing and evaluates the advantages of social media for communication between individuals and companies. However, there is a lack of an effective marketing strategy for enterprises. This paper develops a type of enterprise innovative marketing architecture based on data analysis and wireless networks [13, 14]. The existing enterprise innovation and marketing technology is analyzed and compared with the current wireless network and data analysis techniques in the actual enterprise innovation and marketing problems. We have discussed and designed the architecture scheme of wireless network equipment and data analysis technology and related communication methods. We establish a corporate innovation and marketing framework through wireless networks and carry out a wireless transmission of relevant data and information. Based on the particle swarm algorithm, the enterprise marketing resource optimization model is constructed. The proposed model effectively improves the efficiency level of existing enterprise innovation and marketing management resource optimization. It adapts the enterprise to high-quality development and changing market economy.

2. Background and Literature Review

This section provides the background concerning the use of edge computing technologies in enterprise communication and marketing management.

2.1. Mobile Edge Computing. Mobile edge computing (MEC) provides the possibility to overcome the challenges of the traditional computing model for mobile devices with insufficient computing power and energy storage. Edge computing offloading technology uses computing-intensive and delay-sensitive computing that is difficult to handle by mobile devices. The migration of tasks to the servers surrounding the mobile device not only improves the processing capacity of the mobile device but also ensures the energy rate of the device. The server can be a single network element, or it can integrate its functions into a large node [15, 16].

This kind of architecture scheme is conducive for the server to obtain relevant information in the coverage area through the base station, but there are billing and security issues. Trust evaluation is an effective and lightweight method to deal with malicious node attacks inside nodes. Aiming at the problem of internal malicious attacks on nodes, we propose a multidimensional trust evaluation method to comprehensively evaluate the trust value of nodes. In the node trust evaluation mechanism, the most important link is to collect and use node index information for evaluation. The collected trust index data can be used in the trust formula to calculate the trust value. Commonly used trust indicators in wireless sensor networks include node energy remaining, the number of received data packets, interactive information between nodes, and so on. This paper comprehensively utilizes different indicators of nodes, divides the evaluation of node trust value into direct trust and indirect trust, and determines the method of node trust evaluation according to the environmental location of the node in the network [17].

2.2. Wireless Network. Wireless mobile communication technology has developed rapidly from the second generation (2G) and third-generation (3G) technology to the current fifth-generation technology. Cellular mobile communication technology has undergone many innovations, and the corresponding number of mobile users and smart terminals explosive growth has also taken place [18]. With the continuous advancement of science and technology, mobile users have higher and higher requirements for communication services. More vertical fields such as autonomous driving demand for low latency and the demand for high mobility on high-speed trains put forward higher requirements on wireless networks. The enterprise marketing and innovation architecture design diagram is shown in Figure 1.

More and more new technologies are proposed to meet the needs of users, such as MIMO (multiple-input multiple-

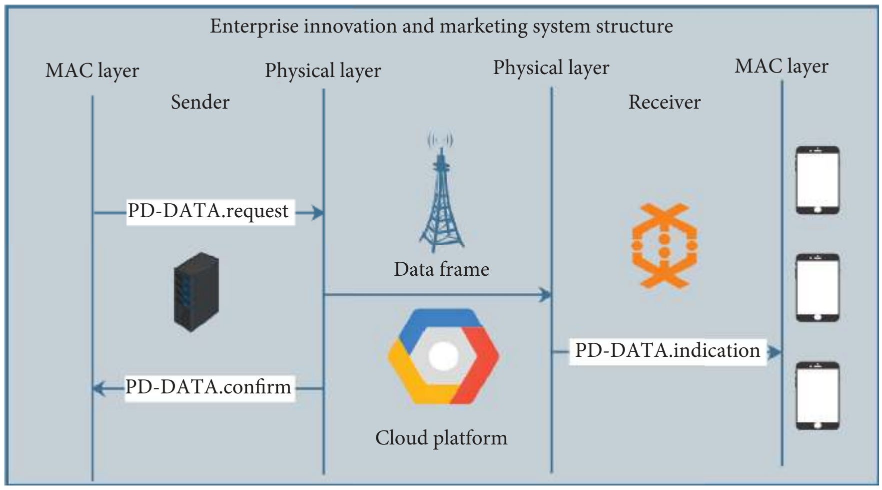

Figure 1: Enterprise marketing architecture.

output), network slicing, ultra-dense cells, mobile edge computing (mobile edge computing, MEC), and other new technologies are in communication technological innovations to meet the needs of future networks for greater throughput and lower latency [19]. Sensor nodes have data fusion capabilities in wireless sensor networks. Due to a large number of sensor nodes, many nodes will collect data of the same type. Therefore, it is usually required that some of the nodes have data fusion capabilities, which can fuse data collected from multiple sensor nodes and then send them to the information processing center. Data fusion can reduce redundant data, which can reduce energy consumption during transmission and extend network life [20].

2.3. Enterprise Innovation and Marketing Management. Marketing strategy management is the core link of the consulting and training industry in the company's operation and management. Marketing is the direction indicator that guides the development of enterprises and determines the success or failure of enterprise operations [21]. How to improve the market competitiveness of an enterprise and achieve healthy and sustainable development requires the management of the enterprise to brainstorm and combine the status quo to find a marketing strategy suitable for the development of the enterprise. A company faces changes in the industry during the development process, and changes in customer training needs are discussed. The company's existing marketing strategy can no longer adapt to the current business environment [22]. Through research and analysis of various problems and challenges that have emerged, combined with the company's current development stage and its advantages, it proposes market positioning and strategic combination plans to help companies solve the current development dilemmas.

Porter's five forces include the competitive ability of current competitors, the ability of potential competitors to enter, the substitute ability of substitutes, the bargaining power of suppliers, and the bargaining power of buyers [23, 24]. The article is used to analyze the industry market environment facing. Due to the scientificalization of corporate marketing strategies and the emergence of many manufacturers, brand marketing has gradually been regarded as one of the best ways to promote the high-quality development of enterprises. There are also more research and analysis on this. Researchers believe that brand marketing strategies include product innovation, price positioning, channel management, and promotion policies, ensuring that the implementation of marketing strategies needs to be refined to brand image promotion and maintenance, and they have given inspiration and suggestions for crisis management.

3. Proposed Innovative Marketing Framework for Enterprises

The proposed framework is composed of two different modules. Initially, a corporate innovation and marketing framework module is established through edge computing to carry out a wireless transmission of relevant data and information at the edges of the network. Later, the enterprise marketing resource optimization module is constructed based on the particle swarm algorithm.

3.1. Enterprise Innovation and Marketing Architecture. The proposed innovation and marketing architecture is based on a wireless network and edge computing. The network is composed of several edges. Currently, companies are pursuing high-quality and long-term development, and brand marketing strategies must fully adapt to changes in the market environment. For modern enterprises, being in line with globalization and keeping up with big data can establish credibility with high-quality brand images and win consumers' praise with high-quality brand services [25, 26]. Such market requirements are equally strict for enterprises. At the same time, the development of the enterprise industry fluctuates greatly, and there are many influencing factors. The international and domestic markets of enterprises are still bad. A schematic diagram of enterprise innovation and marketing management data analysis process is shown in Figure 2.

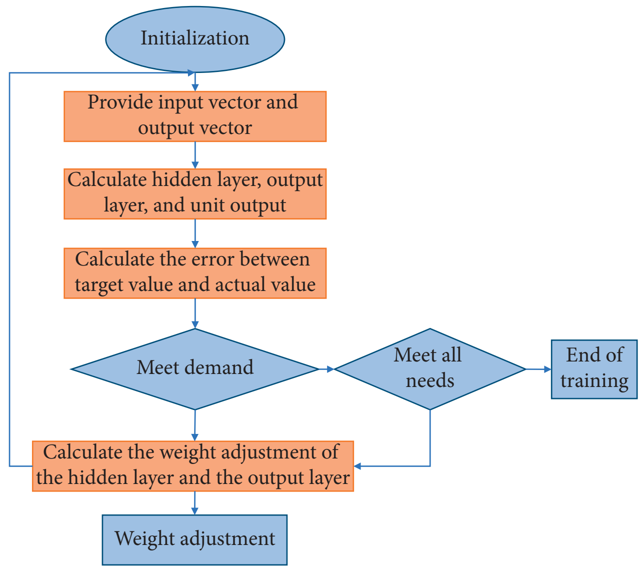

Figure 2: Data analysis process of the proposed framework.

The goal of shaping the high-quality development of an enterprise is to improve the quality of products, especially when the enterprise is seeking high-quality development. High-quality development must emancipate the mind, keep up with the forefront of science and technology, improve the company's target market positioning, and focus on creating quality products and star projects. Enterprises enter the high-end market through high-quality development. Product quality represents brand competitiveness. Without quality assurance, there will be no brand image and no brand competitiveness [27]. The market is cruel. Many small- and medium-sized enterprises are facing bankruptcy. It is high-quality products that customers choose in the market. The creation of high-quality projects is also the basis for the survival of the corporate brand.

3.2. Enterprise Innovation and Marketing Optimization. The proposed optimization module is based on data analysis. Researchers believe that brand marketing strategies include product innovation, price positioning, channel management, and promotion policies, ensuring that the implementation of marketing strategies needs to be refined to brand image promotion and maintenance, and they have given inspiration and suggestions for crisis management. To this end, we will research enterprise innovation and marketing optimization based on data analysis [28]. This kind of architecture scheme is conducive for the server to obtain relevant information in the coverage area through the base station, but there are billing and security issues. Trust evaluation is an effective and lightweight method to deal with malicious node attacks inside nodes. Aiming at the problem of internal malicious attacks on nodes, we propose a multidimensional trust evaluation method to comprehensively evaluate the trust value of nodes.

The particle swarm algorithm comes from the swarm intelligence embodied in the foraging process of fish or birds. In the process of foraging for food, a school of fish or birds uses a one-way flow of information and relies on the judgment of the group to correct the route to find the target [29, 30].

$$\begin{aligned} X \Theta X' &= \{x \mid x \in X \cup X' - X \cap X'\}, \\ \widetilde{P}_2 &= s \cdot P_2 \cdot R + L. \end{aligned} \tag{1}$$

Among them, the individual in the group is not intelligent, and the correction of the target direction only depends on the best direction of itself and the group, and the entire group depends on the information flow of all the monomers to have the intelligent characteristic of being able to judge the position correctly [31, 32].

$$\begin{aligned} Pr[A(X) \in \widehat{D}] &\leqq e^{[X, X']} Pr\left[A(X') \in \widehat{D}\right], \\ E(P_{k1}, P_{k2}) &= \left\| P_{k1} - (s \cdot P_{k1} \cdot R + L) \right\|. \end{aligned} \tag{2}$$

In order to improve the search ability of the algorithm, a particle swarm algorithm with weight coefficients is adopted [33, 34].

$$\begin{aligned} v_{ij}^{e+1} &= W + V_{IJ}^{e} + C_1 * R_1 * \left(pBest_{ij} - P_{ij}^{e}\right) \\ &\quad + C_2 * R_2 * \left(gBest_{ij} - P_{ij}^{e}\right), \\ \Delta P &= P_1(I) - P_1(J). \end{aligned} \tag{3}$$

According to the above analysis, when the initial particle number of the particle swarm algorithm reaches 20, the accuracy and efficiency of the algorithm reach the best state, and the registration correction problem when the information in the image is lacking can be solved [35, 36].

$$W = W_{\max} - (W_{/\max} - W_{\min}) \frac{g}{G}. \tag{4}$$

It is concluded that 20 can be used as the upper limit of the parameter adjustment of the initial particle number of the algorithm, and the algorithm dynamically adjusts the initial particle number under this upper limit [37, 38]. When the number of particles is less than 10, the average maximum mutual information drop rate obtained by the algorithm is accelerated, and the maximum mutual information value drops by an order of magnitude and does not meet the actual registration accuracy required. 10 is used as the lower limit of the initial particle number parameter adjustment [39, 40].

$$s = \frac{tr\left(P_{K1}^{T} \cdot P_{k2} \cdot R\right)}{tr\left(P_{K2}^{T} \cdot P_{k2}\right)}. \tag{5}$$

When the number of particles reaches 15, the average maximum mutual information basically meets the requirements of the actual problem on the efficiency of the algorithm, and 15 can be used as a reference value for the dynamic adjustment of the initial particle number [41, 42].

4. A Case Study: Analyses of Proposed Optimization

4.1. Data Source and Test Environment. In this section, we set up an example scenario, using a cloud server as the cloud service layer and 4 laptops as edge servers to collect the original video of the camera. The server is configured with Intel Xeon CPU and equipped with 8GB memory [43]. The goal of shaping the high-quality development of an enterprise is to improve the quality of products, especially when the enterprise is seeking high-quality development [44]. High-quality development must emancipate the mind, keep up with the forefront of science and technology, improve the company's target market positioning, and focus on creating quality products and star projects. Enterprises enter the high-end market through high-quality development [45, 46]. The comparison of enterprise innovation and marketing management structure rate under different ρ values (SNR = 10 dB) is shown in Figure 3.

The edge server is configured with Intel Core i7-6200U and has NVIDIA GeForce 940MX graphics card. At the same time, the communication bandwidth rate transmitted to the cloud service layer is limited to 1 MB/s. In order to evaluate the performance of the proposed algorithm, a series of simulation experiments are carried out.

4.2. Comparison of Enterprise Innovation and Marketing Network Speed. In the simulation, consider a mobile social network consisting of 5 base stations and 15 D2D transmitters [27]. Assuming that there are a total of 10 types of content distributed in the network, the cache status of each content follows the Markov model, the content popularity follows the distribution, and the morphological parameter is 1.5. In the simulation, the probability of staying in the same state in the buffer state transition probability matrix is set to 0.6, and the transition probability from one state to another state is set to 0.4. For the transmitter, the state transition probability that the buffer state remains unchanged is 0.3. The transition probability from one state to another is 0.74 [47, 48]. The calculation state of the MEC server follows the Markov model. It is assumed that the computing power status of the MEG server is divided into five types: very low, low, medium, high, and very high. The comparison of enterprise innovation and marketing management structure rate under different ρ values (SNR = 10 dB) is shown in Figure 4 [49].

Figure 4 shows the convergence of the proposed DRL-MSN resource joint allocation scheme. It can be seen from the figure that in the initial stage of the learning process, the total utility value of the DRL-MSN scheme is very low. As the number of nodes increases, the total utility continues to increase until it converges to a relatively stable value, about 5900. In addition, the convergence performance of deep reinforcement learning algorithms under different learning rates is compared. When the learning rate is 0.001, the convergence speed is faster than when the learning rate is 0.0001. However, this does not mean that a higher learning rate is always better because a higher learning rate may lead to a local optimal rather than a global optimal. For example, when the learning rate is 0.01, the algorithm converges to about 4900, which is much lower than the convergence value obtained by other learning rates. Therefore, it is important to choose the right learning rate for a particular problem. In the following simulation, a learning rate of 0.001 was selected.

4.3. The Impact of Data Analysis and Optimization on Experimental Results. In the above, the data source and the prediction model built are introduced in detail. For a neural network prediction model or other machine learning algorithm model, it is necessary to judge the pros and cons of the prediction algorithm based on the quantitative measurement of its prediction performance. At the same time, for a built model, there are many changes in the parameters of the model. The model needs to be tuned to make the prediction results accurate. The changes of corporate marketing indicators under different methods are shown in Figure 5.

In the following, first the evaluation index used in this article and the meaning of the evaluation index are introduced, and the parameters of the model built in this article are selected. After that, the prediction results of the model built in this article are shown, and the prediction results of other machine learning algorithms to prove its superiority are compared. The effect diagram of enterprise innovation and marketing management optimization-Gaussian noise is shown in Figure 6.

Figure 7 shows the effect diagram of enterprise innovation and marketing management optimization under data optimization. The impact of the average size of each content on the total reduced backhaul link traffic. It can be seen from the figure that as the average size of each content increases, the reduced backhaul link traffic will increase. The effect of enterprise innovation and marketing management optimization-salt and pepper noise is shown in Figure 7.

The gain of cache utility decreases, and the system tends not to cache, which leads to a decrease in cache revenue. Therefore, the traffic on the backhaul link is reduced even more. In addition, without indirect observation of the trust value of mobile users, the accuracy of the social trust value evaluation of the DRL-MSN-wind scheme is low, which

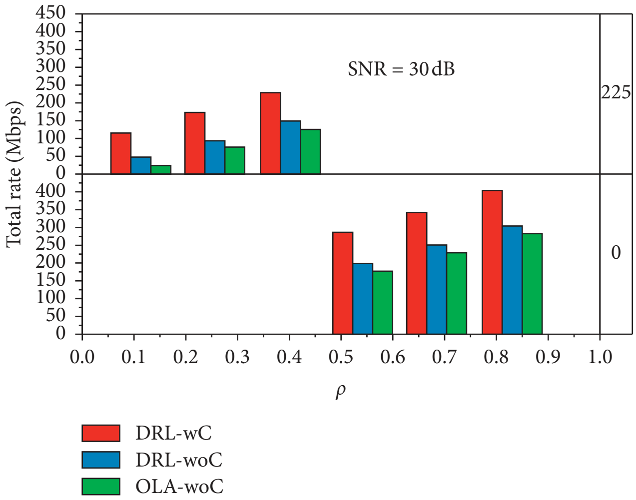

Figure 3: Comparative analysis: rates under different ρ values (SNR = 30 dB).

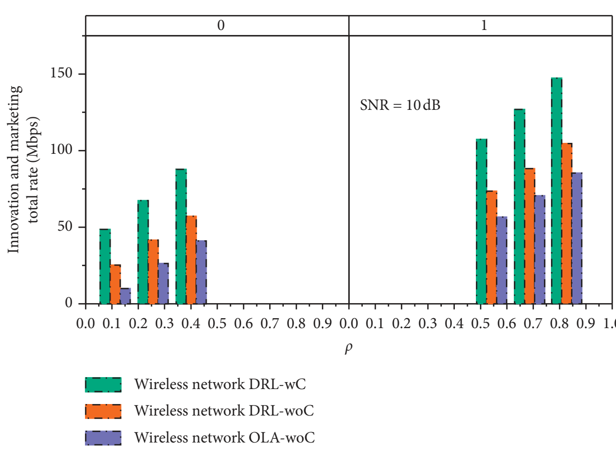

Figure 4: Comparative analysis: rates under different ρ values (SNR = 10 dB).

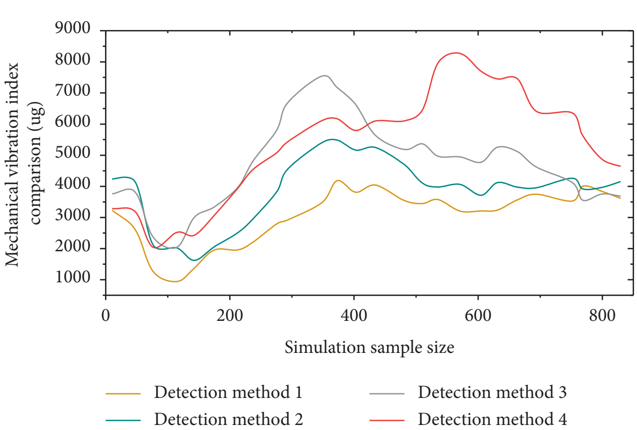

Figure 5: Changes in corporate marketing indicators under different methods.

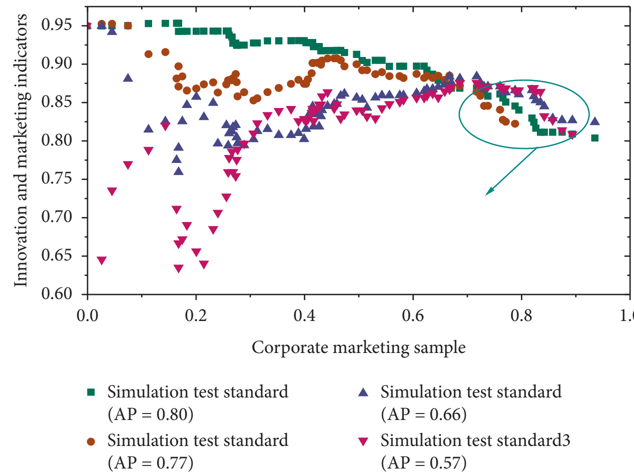

Figure 6: The effect of the proposed optimization-Gaussian noise.

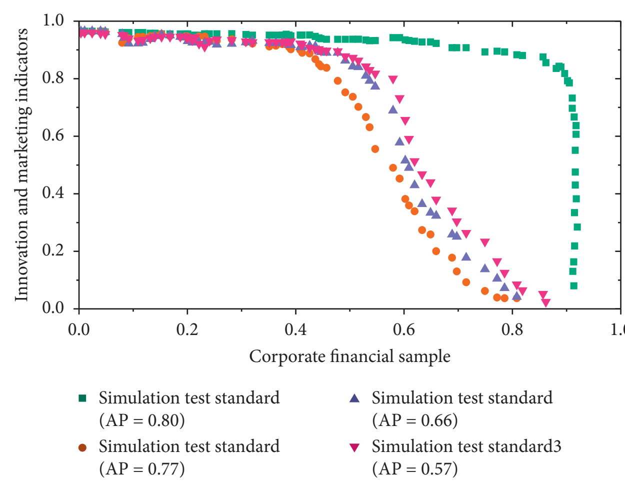

Figure 7: The effect of the proposed optimization-salt and pepper noise.

leads to MEC and cache. The utility gain is reduced, and the traffic of the backhaul link is increased.

5. Conclusion

This article puts forward a novel enterprise innovation and marketing model to overcome the challenges faced by the enterprises. This article proposes a new resource optimization scheme that combines data mining and wireless network. We establish enterprise innovation and marketing structure through a wireless sensor network with the advent of edge computing and carried out the wireless transmission of relevant data and information at the edge of the network. The proposed model comprised of an edge-enabled corporate innovation and marketing framework module for wireless transmission of data and the enterprise marketing resource optimization module using the particle swarm algorithm. The proposed framework performs efficient calculation and storage using a resource optimization module. The feasibility and effectiveness of the proposed framework are verified using the analysis of the actual case test results. This proposed framework can effectively improve the innovation efficiency level of existing enterprises and the optimization of marketing management resources.

Data Availability

The data used to support the findings of this study are obtained from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest regarding the publication of this paper.

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