Advances in Computer, Signals and Systems (2024)
Clausius Scientific Press, Canada

DOI: 10.23977/acss.2024.080703
ISSN 2371-8838 Vol. 8 Num. 7

# *Blockchain Technology Marketing Sustainable and Accurate Push System Based on Big Data and Internet of Things*

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***Keywords:*** Marketing Management; Big Data; Internet of Things; Blockchain Technology; Sustainable Precision Push System

***Abstract:*** With the development of big data and Internet of Things technology, blockchain technology is more and more widely used in the marketing field. The blockchain technology marketing sustainable and accurate push system based on big data and Internet of Things can provide enterprises with more accurate and effective marketing solutions, thus achieving sustainable development. To this end, this paper designed the marketing sustainable precision push system based on big data and the IoT drive, and analyzed the performance and effect of the system through the collaborative filtering algorithm. The results showed that when other conditions were the same, the number of employees who had positive evaluation on system A was 23, accounting for 92%, while the number of employees who had positive evaluation on system B was only 3, accounting for 12%. The precision push effect of system A is significantly better than that of system B, indicating that big data and IoT drive are conducive to improving the performance of the marketing sustainable precision push system, and the relationship between them is positive.

## 1. Introduction

In recent years, mobile Internet and IoT technology have developed rapidly and gradually penetrated into all aspects of social production and life. The popularization of the IoT technology has promoted the construction of smart cities, such as the implementation of the “Internet plus” and the “the Belt and Road” strategies, as well as the application of the IoT technology in transportation, agriculture, environmental protection and other aspects, which have provided strong support for social and economic development. In terms of marketing, Internet information technology is different from traditional media in terms of business model and marketing concept. In the form of traditional media marketing, the audience can only receive the advertisements or information provided in the specific media content. In the context of the IoT and big data, marketing communication can receive the information of the audience at any place.

With the continuous development of Internet technology, the enterprise marketing environment has also undergone great changes. In the era of big data and the IoT, people can analyze consumer

behavior and achieve accurate marketing through big data and the IoT technology. In personalized push, big data and IoT technology have become important technical means. Personalization is a kind of high recognition of user value, and the pursuit and recognition of products, services, concepts and other aspects based on market demand. Precise push through big data and IoT technology is also a marketing method in line with the development trend and laws of the future Internet. The combination of big data and the IoT provides a good environment for accurate push. It can help people analyze user behavior, user portrait, and recommend products or services according to user habits. At the same time, the combination of cloud computing and other technologies provides good conditions for people to achieve accurate push.

Based on this, this paper first combines the development characteristics of big data and the Internet of Things, and adopts collaborative filtering algorithm to design and optimize the sustainable and accurate push system of blockchain technology marketing. Then, the designed system is tested to verify its good performance. Finally, X marketing enterprises are tested in practice. Through participating in the evaluation of employee satisfaction and precision push effect, it is concluded that big data and Internet of Things drive have a good effect on the optimization of blockchain technology marketing sustainable precision push system.

## 2. Related Work

With the deepening development of reform and opening up, China's economy has achieved rapid development, and the importance of marketing has gradually emerged. More and more people have begun to study it. Among them, Erkin Gulomkhasanov's research found that marketing was a process that affected people's lives. People are consumers, but many people are part of marketing, such as salesmen, wholesalers, competitors, raw material suppliers, etc. As people know, the concept of marketing has been constantly redefined. Marketing defines activities that create value through communication between both parties. This concept is the traditional definition of marketing [1]. In the past decade, the emergence of the sharing economy and the rise of various studies on this subject within and outside the marketing discipline. However, the impact of sharing economy on marketing ideas and practices is still unclear. Therefore, Eckhardt Giana M. proposed a series of forward-looking guidelines, and emphasized the impact of the paradox, maturity and technological development of the sharing economy on marketing research, aiming to help marketing scholars not only keep up with the pace of the sharing economy, but also shape its future direction [2]. The contribution of psychology to marketing is very important and valuable. No discipline can gain more benefits from another discipline than marketing from psychology. In order to understand the scientific contributions made by the intersection of psychology and marketing, Donthu Naveen conducted a bibliometric review of a top journal devoted to the application of psychological theory and technology to marketing: psychology and marketing [3]. However, the above studies are all theoretical studies aimed at marketing and lack of systematic analysis. Therefore, scientific methods are urgently needed.

In response to the above problems, the combination of big data technology and marketing has become the focus of scholars' attention, and a lot of research has been carried out in relevant fields. Among them, the expansion of AI, big data and the Internet is creating a marketing revolution, making the 4p (product, price, place, motion) style of the 1960s more and more outdated. The diversified and inclusive socio-economic factors, as well as the major geopolitical threats, make the problems faced by marketers more complex. Therefore, Rust Roland T explored the essence of change, extrapolated marketing practice to the future, and studied the impact on marketing managers, marketing education and marketing academic research [4]. In view of the research interest in big data in marketing, Amado Alexandra proposed a research literature analysis based on

the semi-automatic method of text mining to determine the main trends in this field. The research found that the application of big data to marketing was still in its infancy. Therefore, it is essential to make more direct efforts for the development of big data in the field of marketing [5]. These studies illustrate the applicability of big data in the field of marketing, and lay a solid foundation for its combination with the IoT drive and its application to the construction of the marketing sustainable precision push system.

## 3. Construction of Marketing Sustainable and Accurate Push System Driven by Big Data and the IoT

### 3.1 Design of Marketing Sustainable and Accurate Push System

(1) Realization of sustainable and accurate marketing push system in the era of big data and the IoT,

1) Concept of big data

Big data, as the name implies, is a collection of massive data. Because massive data cannot be used by relevant instruments and programs in a short time, it is necessary to integrate these data to obtain more useful information. Big data has exceeded all the software processing capabilities of traditional databases. It cannot be directly used as value information and needs to be processed. In the world where human beings live, they are surrounded by "data" all the time. Although they cannot be perceived with eyes, they are always there. Daily phone calls, microblogging, WeChat chat, website visits, medical inquiries, tourism and sightseeing are all contributing to a huge amount of big data. Big data has never left.

2) Concept of IoT

The concept of the IoT was put forward for the first time in the last century and has become the representative of a new generation of technology. With the continuous breakthroughs in theory and technology, it has evolved from a narrow concept to a broader concept. Today's IoT is the prototype of the third generation of Internet, emphasizing the communication between people, people and things, and things and things. Through the IoT, the transformation from virtual to reality has been realized, and the limitation of communication between people has been broken. The ultimate goal of the IoT is to make everything interconnected. Among them, the sensor network, gateway and server constitute the IoT system. The overall design of the IoT system is divided into three layers: perception layer, network layer and application layer. The perception layer obtains the environment information and transmits the information at the network layer. The application layer is the ultimate product of application products that can provide multiple functions.

In order to solve the shortcomings of traditional marketing and help enterprises achieve the goal of precision marketing, it is necessary to use the IoT technology for data integration and data analysis and processing. In the era of big data, enterprises can combine big data and IoT technology to achieve comprehensive analysis and in-depth mining of user needs. Through comprehensive collection and in-depth mining of user data, enterprises can better analyze the needs and preferences of target customer groups. For all kinds of problems and user behavior patterns in the marketing process, targeted treatment can be carried out, which can help enterprises better achieve precision marketing. Big data and IoT technology provide enterprises with more ways and means of market research, which can help enterprises find target customer groups and potential customers through big data analysis, and grasp their needs in a timely manner.

(2) Marketing precision push system scheme introduction based on big data and IoT technology

Based on big data and IoT technology, the scheme design of marketing precision push system should first do a good job in user portrait, which requires enterprises to combine their own brand advantages and customer portrait analysis. The target audience is subdivided according to different

labels, and the target users are found through the collection and analysis of user characteristics. Secondly, according to the product characteristics, customer groups, marketing purposes, time range, etc., the push strategy is formulated, and whether there are potential customers is analyzed according to the customer group characteristics, geographical location and other information. Finally, the corresponding push strategy should be formulated according to the product positioning. The push content can be product introduction, promotional activities and other information. Through the above analysis, it can be known that in marketing, enterprises can use big data and IoT technology to classify users and label them. Through the analysis of big data technology, customers who have purchase intention or have purchased but have not yet purchased can be found. If an enterprise wants to realize the personalized precision push function, a personalized precision push system needs to be built.

(3) Overall architecture of the system

The system takes application server and database management server as the core, and is responsible for system operation and data management respectively. Customer managers, market managers, district and county marketing department managers and municipal marketing center managers can use personal computers to access and use the system through Internet services. When the account manager and marketing manager are away, they can use smart phones to access. The system has firewall, access control and other security functions. It is also connected to the upstream system, mainly the personnel system and inventory system of the marketing company, as well as the manual data input part [6-7]. The network topology is shown in Figure 1.

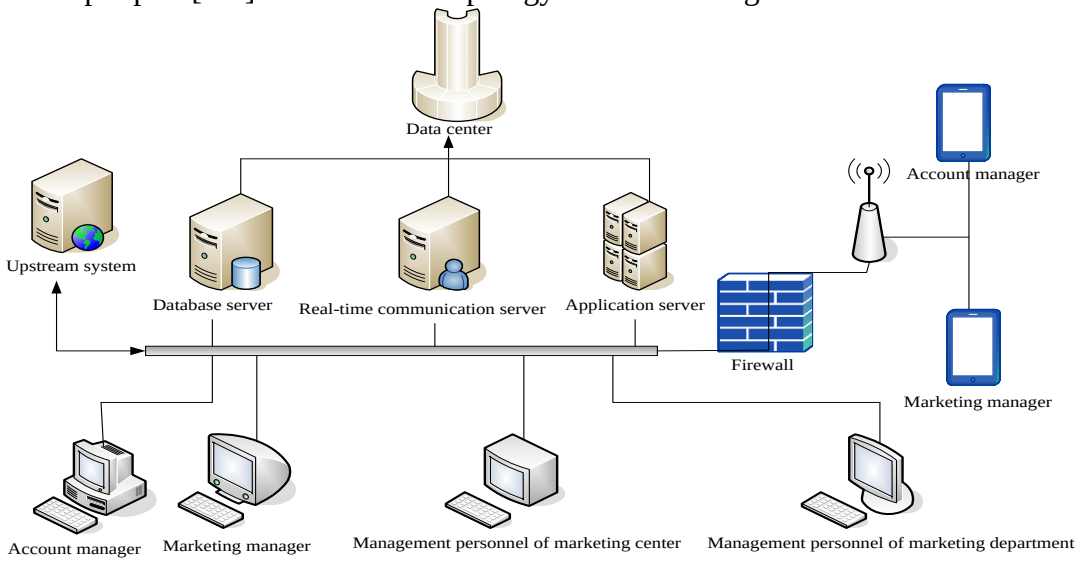



Figure 1: Network topology of regional and municipal marketing sustainable precision push system

The data of the regional and municipal marketing sustainable precision push system comes from three aspects: department accumulation, market research and customer visit. These data provide services for marketing management, brand building, consumption analysis, sales analysis and other services to achieve accurate information management, sustainable and accurate marketing delivery and fine management [8-9].

## 3.2 Collaborative Filtering Algorithm Driven by Big Data and the IoT

In the era of big data, personalized recommendation system is at a new stage of development, and the quality of its recommendation algorithm directly affects the user's travel experience. Compared with other recommendation algorithms, collaborative filtering algorithm has no special

requirements. Whether it is analytically structured, or difficult to analyze, such as personal taste, audio, image and other unstructured, it can achieve a very good effect through collaborative filtering algorithm. Therefore, based on the collaborative filtering algorithm driven by big data and the IoT, the marketing sustainable precision push system is optimized to improve the effect of precision recommendation [10-11].

Collaborative Filtering Algorithm

Collaborative filtering technology is to calculate the similarity between preferences based on user preferences, and automatically filter information for users based on it. At the same time, because the data of this method comes from historical behavior, search records and evaluation of tourist attractions, when analyzing the user's interests and preferences, it has no impact on the user's access, and the user experience has been greatly improved.

The method mainly includes three stages. Firstly, high and low dimensional data are used to construct user preference matrix. Secondly, the corresponding formula is used to find the nearest neighbor set. Finally, the final recommendation result is obtained by analyzing the same or similar information with users.

Collaborative filtering algorithm based on User-Item

The core idea of User-Item collaborative filtering recommendation algorithm is to find data sets with similar or identical user preferences, and recommend information based on the preference information of target users. It is consistent with the recommendation process of collaborative filtering algorithm, which is divided into three stages. The first is to classify preference information and create a score matrix for evaluating users and projects. The second is to find the neighbor set with the best similarity between users and projects. The third is to recommend the first M items in the neighbor collection to users and use them as a new collection. The specific description of the algorithm is as follows:

1) The representation of the user scoring matrix: $n$ and $m$ represent the user's evaluation results and the number of items, and $T_{n\times m}$ represents the scoring matrix. The rows and columns of the matrix represent the number of users and items respectively. $T_{ok}$ represents the score of the $o$-th user on the $k$-th item. Users can use the Boolean method with a value of 0-5 distribution to score items. 1 is used to indicate that users are interested in information or have purchased it. 0 indicates that the user is not interested in the information or has not purchased it. The size of the value can also be used to represent the user's preference value. The larger the value, the more interested the user is, as shown in Table 1.

Table 1: Average score T of User-Item

| User-Item | $O_1$ | ... | $O_k$ | ... | $O_n$ |
|---|---|---|---|---|---|
| $I_1$ | $T_{11}$ | ... | $T_{1k}$ | ... | $T_{1n}$ |
| ... | ... | ... | ... | ... | |
| $I_o$ | $T_{o1}$ | | $T_{ok}$ | | $T_{on}$ |
| ... | ... | ... | ... | ... | ... |
| $I_m$ | $T_{m1}$ | | $T_{mk}$ | | $T_{mn}$ |

2) Neighbor formation: The relevant formula in the collaborative filtering algorithm is used to calculate the similarity between users, and find users with similar or identical interests, so as to obtain their closest neighbor set. The most critical step is to find the nearest neighbor set based on User-Item, that is, generate a neighbor set $R_i = \{r_1,..., r_m\}$ for target user $i$.

The similarity of interests and preferences between users can be used to judge the advantages and disadvantages of an algorithm. There are three methods of similarity measurement, namely

cosine similarity, modified cosine similarity and Pearson correlation.

Cosine similarity: The cosine value of the angle between two vectors is used as a criterion to measure similarity, which is called vector similarity. Vector $\vec{i}$ is the user's score in the $m$ -dimensional space. Therefore, the similarity $sim(o,k)$ of users $o$ and $k$ in $m$ -dimensional space is:

$$sim(o,k)=\cos(\vec{o},\vec{k})=\frac{\vec{o}\times\vec{k}}{|\vec{o}|\times|\vec{k}|}=\frac{\sum_{h=1}^{m}T_{oh}T_{kh}}{\sqrt{\sum_{h=1}^{m}T_{oh}{}^{2}}\sqrt{\sum_{h=1}^{m}T_{kh}{}^{2}}} \tag{1}$$

In Formula (1), $\vec{o}\times\vec{k}$ is the product of the inner product of vector $\vec{o},\vec{k}$ , and $|\vec{o}|\times|\vec{k}|$ is the product of vector $\vec{o},\vec{k}$ modules. $T_{oh}$ and $T_{kh}$ are the scores of the $o$ -th and $k$ -th users on item $h$.

Modified cosine similarity: Different users have different fractional scaling problems, while cosine similarity lacks consideration for this problem. Therefore, the average method is adopted to calculate the average score of users, so as to reduce the data loss caused by the proportion of scores, and achieve the correction of cosine similarity. Since the effective set has evaluation scores, the average value of each score is not blank. The user score and average score are calculated first, and the cosine of the vector angle is calculated. Finally, the similarity $sim(o,k)$ between users $o$ and $k$ can be expressed as follows:

$$sim(o,k)=\frac{\sum_{h\in O_{ok}}(T_{oh}-\overline{T}_{o})\times(T_{kh}-\overline{T}_{k})}{\sqrt{\sum_{h\in O_{o}}(T_{oh}-\overline{T}_{o})^{2}}\sqrt{\sum_{h\in O_{k}}(T_{kh}-\overline{T}_{k})^{2}}} \tag{2}$$

In Formula (2), $\overline{T}_{o}$ and $\overline{T}_{k}$ are the average of the number of items scored by users $o$ and $k$, and 5 $O_{ok}$ is the set when the scores of two users intersect[12-13].

## 4. Experiment of Marketing Sustainable and Accurate Push System Driven by Big Data and the IoT

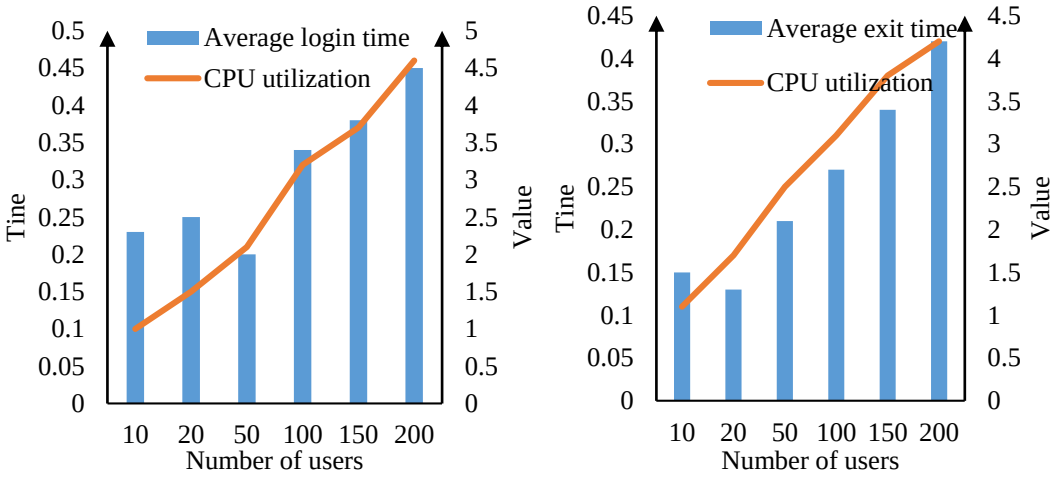
### 4.1 Performance Test

The purpose of performance test is to test the system requirements and performance indicators at the design stage, including the response time of the system, the accuracy of calculation results, and the security of data. At the same time, it is necessary to find out the problems of the marketing sustainable precision push system and provide reference for the system optimization during its expansion [14-15].

Concurrent testing is a meaningful test in the marketing sustainable precision push system. Using the operation of simulation software, the number of users that can be supported under normal working conditions and extreme operation is estimated to detect the implementation of core functions of the system under different user numbers.

In the performance test of the marketing sustainable precision push system, four business sites,

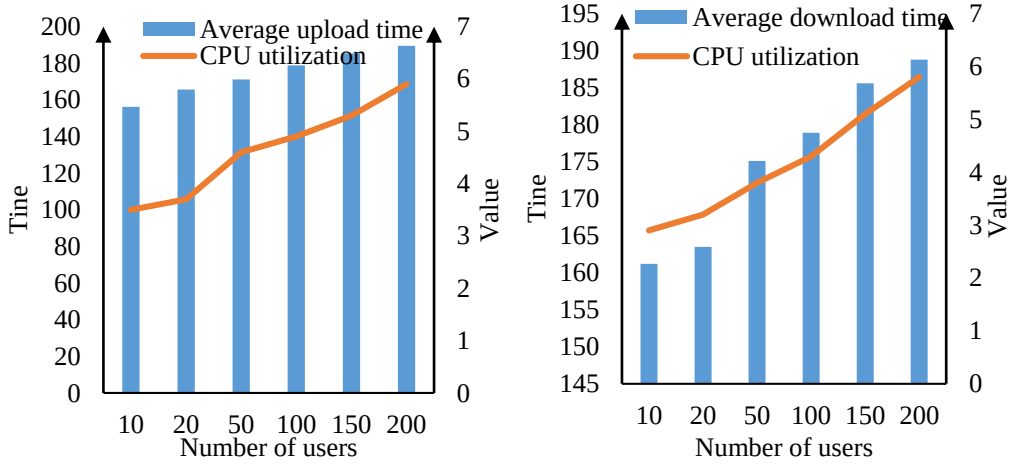
namely, users logging in and out of the marketing sustainable precision push system, uploading and downloading files, were selected for the system performance test. In the process of testing, the automated performance testing software was first used to initialize 20 users. Then, at the speed of adding 10 users in 2 seconds, the operation of virtual users on the platform was increased. Finally, after 200 virtual users were added, the system performance test was completed. This paper recorded the data of 10, 20, 50, 100, 150 and 200 users when logging in and out of the system, uploading and downloading files. This has been repeated 20 times to take the average value. The average size of the file was 1G, as shown in Figures 2 and 3.




(a) System login (b) System logout

Figure 2: Average time and CPU utilization during system login and logout

It can be seen from Figure 2 (a) that the average system login time was 0.23S, 0.25S, 0.20S, 0.34S, 0.38S and 0.45S respectively, and the CPU utilization rate was 1.0%, 1.5%, 2.1%, 3.2%, 3.7% and 4.6% respectively. It can be seen from Figure 2 (b) that the average logout time of the system was 0.15S, 0.13S, 0.21S, 0.27S, 0.34S, and 0.42S, and the CPU utilization was 1.1%, 1.7%, 2.5%, 3.1%, 3.8%, and 4.2% respectively. It can be seen from Figure 2 that the average time of system login and logout is within 0.5s, and the CPU utilization rate has been kept below 5%, which basically meets the demand of marketing sustainable and accurate push system.




(a) Upload file (b) Download file

Figure 3: Average time and CPU utilization when the system uploads and downloads files

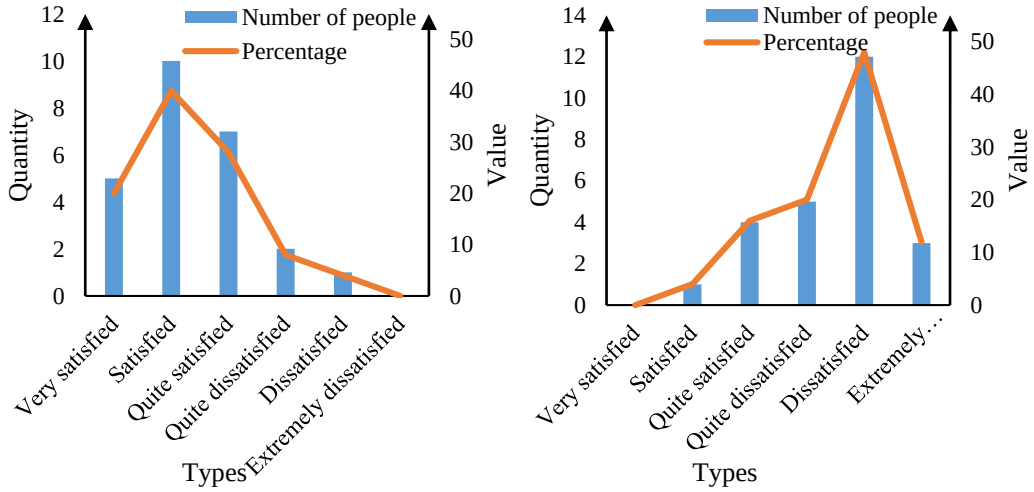
It can be seen from Figure 3 (a) that the average time for the system to upload files was 156.2S, 165.6S, 171.1S, 178.8S, 185.4S and 189.5S respectively, and the CPU utilization was 3.5%, 3.7%,

4.6%, 4.9%, 5.3% and 5.9% respectively. It can be seen from Figure 3 (b) that the average time for the system to download files was 161.2S, 163.5S, 175.1S, 178.9S, 185.6S and 188.8S respectively, and the CPU utilization was 2.9%, 3.2%, 3.8%, 4.3%, 5.1% and 5.8% respectively. It can be seen from Figure 3 that the design of the marketing sustainable precision push system meets the requirements.

## 4.2 Practical Application of Marketing Sustainable Precision Push System

This paper selected X marketing enterprise in a city as the research target, and compared the system (A system) of this paper with the system (B system) currently used by the enterprise. In order to reduce the impact of other factors, this paper selected 50 employees of the enterprise as the subjects of the experiment. Among them, 25 employees have evaluated the satisfaction of the system, and the other 25 employees were the target of accurate push to evaluate the effect of accurate push. The test time was half a year. After the test, the satisfaction of the two systems and the effect of accurate push were investigated. In order to understand the employees' satisfaction with the two systems and the precise push effect, this paper prepared 50 questionnaires and collected 50 questionnaires.

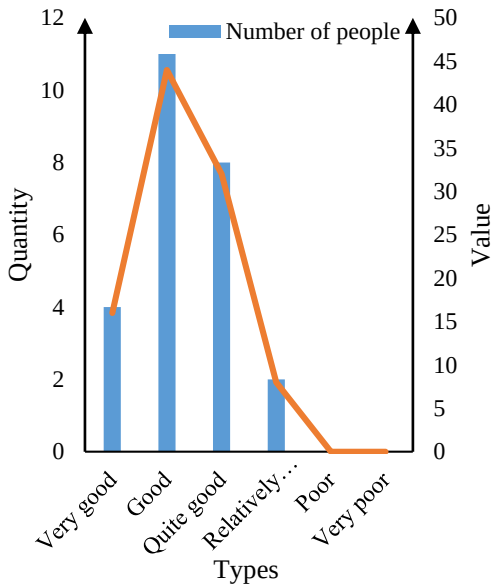
Through sorting out the questionnaire, this paper made statistics on the satisfaction of employees and the effect of accurate push. The results are shown in Figure 4 and Figure 5.



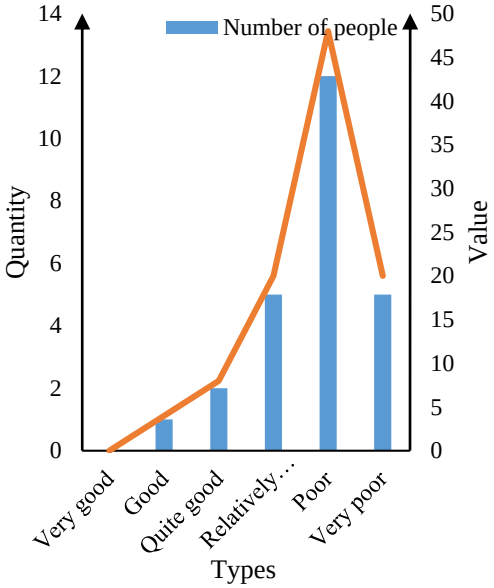

(a) A system satisfaction (b) B system satisfaction

Figure 4: Satisfaction analysis of the two systems

It can be seen from Figure 4 (a) that there were 5 employees who were very satisfied with system A, accounting for 20%. The number of satisfied people was 10, accounting for 40%. Seven people were satisfied, accounting for 28%. There were 2 people who were dissatisfied, accounting for 8%. One person was dissatisfied, accounting for 4%. There was no very dissatisfied evaluation. It can be seen from Figure 4 (b) that the number of employees who were satisfied with system B was 1, accounting for 4%. The number of people who were relatively satisfied was 4, accounting for 16%. It can be seen from Figure 5 that the marketing sustainable and accurate push system driven by big data and the IoT is more popular with employees.




(a) Precise push effect of system A




(b) Precise push effect of system B

Figure 5: Effect of precise push of two systems

It can be seen from Figure 5 (a) that the number of employees who thought that the precise push effect of system A was very good was 4, accounting for 16%. There were 11 good people, accounting for 44%. The number of good people was 8, accounting for 32%. The number of relatively poor people was 2, accounting for 8%, and there was no poor or very poor evaluation. It can be seen from Figure 5 (b) that the number of employees who thought the accurate push effect of system B was good is 1, accounting for 4%. The number of better people was 2, accounting for 8%. The number of relatively poor and very poor people was 5, accounting for 20%. The number of poor people was 12, accounting for 48%.

## 5. Conclusions

In the era of big data and the IoT, enterprises can use information technology and equipment data to better understand the needs of consumers, so as to accurately push products or services. The design and implementation of the marketing precision push system driven by big data and the IoT aims to solve the current problems of poor marketing effect, inaccurate data statistics, single push channel and data security, so as to provide users with accurate and reliable consumption environment. The market sales data were mined, analyzed and processed, and the IoT technology was used to build the terminal equipment and network environment. On this basis, the communication and data transmission between the device end and the terminal were realized, so as to achieve sustainable and accurate marketing push.

## Acknowledgement

This work was supported by the High-level Talent Research Initiation Project of ZhongShan Polytechnic (Research on Corporate Brand Communication Strategy from the Perspective of Digital Marketing Reconstruction, Project No. KY2210).

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