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Design of Information Monitoring System Based on Internet of Things and SOM Algorithm

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Abstract: The term "Internet of Things" refers to the collecting of data by several sensors and its transmission to a monitoring center to assist in early problem detection and pinpoint problem locations. This can reduce outside-store monitoring and information in real-time without leaving the earth. You need functionality that each layer module needs to know, and you need to know low power consumption, high concurrency, large databases, security, scalability and high timeliness. In order to improve the performance of the information monitoring system and meet the interests. of industry development, we changed existing information monitoring systems by adding Internet of Things and SOM algorithms. Experimental results have been developed. Internet -based information monitoring systems and SOM algorithms are more effective than traditional monitoring systems. The speed of monitoring advanced information is important, and monitoring errors and false positives have been significantly reduced, from the original 0.125 to 0.032. The cost of monitoring information has dropped significantly, and the price has dropped from the traditional 0.842 to 0.321. This suggests that Internet -based intelligence information monitoring systems can provide complete digital and informative solutions for enterprise performance and management, as well as effective management at all levels of employee management. Real-time monitoring capabilities and production planning capabilities, thus improving the level of technical control of the company.

1 Introduction

Our nation is currently going through a new normal era of economic development, which means China's industrialisation must make some new decisions. The Internet of Things industry, which is still relatively young, has contributed significantly to the economic development of our nation. The Internet of Things sector is viewed as being crucial to national growth in our country [1]. With the development of science and technology, as well as the continuous updating of social needs, more and more fields involve the Internet of Things technology. Therefore, the demand for this technology is growing and is becoming a new development trend [2].

However, the information monitoring system still has major problems such as weak technical level, lack of professional guidance, lack of monitoring system, poor data preservation, lack of emergency response plans, and inefficient operation and management. The effectiveness of information operation is significantly impacted by the operation management degree of information monitoring. Information monitoring is characterized by its complicated infrastructure and dispersed design. In order to improve the performance of information processing, it is necessary to carry out real-time monitoring and automatic control of main facilities and important parameters through technical means [3]. At the same time, the proportion of large-scale group operations in the current information monitoring industry in our country is increasing. How to enhance the relevance of production operations and resource scheduling between the group and its subsidiaries is an issue worthy of attention [4]. The larger the scale of the information monitoring system and the higher the complexity of its composition structure, the more urgent the need for a unified management rhythm [5]. The quick and correct transfer of information between multiple components is a crucial step in achieving the unified management of the information monitoring system. Therefore, information monitoring and information management came into being. In recent years, it has become an important development direction to realize the organic integration of conventional data and network information methods with the help of intelligent monitoring and management system processing process. In this mode, the automatic and accurate acquisition of massive data is the basis of informatization. After the data is transmitted to the monitoring management platform via the network data, it will be statistically analyzed and summarized and archived through the software to provide a basis for decision-making for production operation and management. With the continuous improvement of informatization and intelligent monitoring technology, the management and operation mode of informatization and intelligence will be more dependent on [6]. The use of Internet of Things technology to collect and integrate data and information at all levels of the automatic control system, after analysis, is used to guide the operation and management, and the realization of intelligent monitoring and refined management has a certain degree of standardized operation, energy saving, consumption reduction, and efficiency reduction.

Zheng Liping proposed the use of ARM single-chip microcomputer to develop a soil information acquisition system, which can directly obtain information on-site through the single-chip microcomputer. The disadvantage is that it can only realize soil information monitoring in a small area, cannot monitor a large area, and does not have the function of remote monitoring. Xue Fei proposed to use STM32 single-chip microcomputer and LabView host computer software to construct an intelligent information acquisition system. The advantage is that it can monitor data on-site and remotely. The disadvantage is that it does not have the function of large-area monitoring, and the use of the host computer software is relatively limited and inconvenient to watch. Guo Yanchang proposed a rural network information system design based on ASP.NET. The advantage is that the website can provide farmers with reliable information and a set of visual websites. The disadvantage is that the data collection function and data transmission function are not realized, and the data cannot be analyzed and processed. Shi Miaomiao is based on ZigBee technology and Kingview6.5WEB version of the host computer software, and realizes remote monitoring of facilities. The advantage is that it can use ZigBee wireless sensor technology to realize data acquisition node networking and transmission. The disadvantage is that the monitoring center software does not support multiple platforms and multiple users at the same time [7].

This research is based on the theory of the Internet of Things, with the goal of information monitoring informatization, and designed an information intelligent monitoring system in light of the low efficiency of information monitoring operation in our country, lack of effective supervision, and extensive operation mode. This research starts from the perception layer and the network layer.

The construction of information intelligent monitoring system is carried out on three levels, including the application layer, and the core technology and key content of the construction and operation of the intelligent monitoring system are studied [8]. Through the realization of the Internet of Things centralized management and control of the three main links of the regional information input, production and discharge, the intelligent monitoring system can achieve the goals of digitalization, intensification and intelligence of management; through the analysis of key production indicators and production operation data. The system may achieve improved manufacturing process management and control and achieve standardized management's objectives, energy saving, consumption reduction, staff reduction, and efficiency through automatic collection, remote monitoring, and intelligent early warning.

2 Information Monitoring System Design Method

2.1 Internet of Things

In the early days of Internet of Things technology, the service was a single radio frequency identification technology [9]. This technology can also integrate with the Internet, and contracts are required when working on integration. Real-time data identification is the initial stage's primary purpose. The richness of human research on the Internet of Things has resulted in a wide range of early insights. The Internet of Things can be used at several venues. Therefore, these technology subjects use many sensors and wireless network technologies to transform the actual environmental information of the real estate world into data, and then disseminate and communicate to help people become smarter [10].

As civilization develops, it is becoming more and more usual to combine the Internet of Things with all facets of society; but, doing so while also monitoring information is not practical. It is a product of social development. The Internet application of objects for information monitoring has accelerated the development of information monitoring technology. The Internet of Things collects and disseminates information, analyzes data, and manages content under monitoring information. You can provide a unified communication system. No more programs must be incorporated once all operating systems are operational, which can lower the cost of the information monitoring system. In addition, it can respond to emergencies through timely monitoring, and can also reduce losses.

Sensor data is received and sent over the ZigBee network. However, the data transfer distance of this wireless network is limited. This requires high quality data transfer technology to capture data packets sent by the ZigBee network, and then proceed directly to the user service application. Visually, it is choosing 4G technology, this technology is not only fast, but also very high data transfer quality, it can meet the monitoring data transfer requirements, so you can decide the remote information monitoring system monitoring system.

Through sensors and radio frequency technologies, the Internet of Things gathers and mines massive volumes of data in real time. The Internet of Things Materials contain properties related to size, polymorphism, energy, and others. Big Data offers improved data processing skills and accurate data in the Internet of Things environment. Without data support compatibility, an efficient information monitoring system in an Internet of Things environment cannot function due to high requirements. The handling of data, its acquisition, and its mining for meaningful data information are all under scrutiny in this domain.

2.2 Information Monitoring

The Internet of Things-based information monitoring system's data gathering, transmission, and storage operations are all integrated into a single system [11]. This system is based on information collection methods, coupled with IoT gateways, such as ZigBee and GPRS combined to send data to the cloud, and finally provide users with various services based on the IoT cloud platform. For example, the Internet of Things cloud platform can provide various data real-time query functions and various sensor historical data. This is a part that is difficult to achieve in traditional methods. Of course, we will also provide information that people pay attention to and news that are beneficial to production. Of course, as big data and artificial intelligence advance, the IoT cloud platform will be able to implement intelligent monitoring based on the vast amounts of data acquired by sensors and integrated with other technologies [12].

New types of sensors using new materials and new technologies have also emerged on the market with the quick growth of sensor and Internet technology. Various sensors with high sensitivity, high applicability, and high reliability are becoming embedded, modular, Intelligent development. Developed countries such as Germany and the United States are leading the world in sensor technology and sensor manufacturing technology.

The sensor is the core of data collection. It is a device that converts non-analog quantities into analog quantities through various physical, chemical, biological and other properties, and then converts the analog signals into digital signals, and the single-chip microcomputer and computer can obtain the information that needs to be collected. In our entire system, the selectivity of the data acquisition module is too wide, and there are multiple options for different scenarios. We are not limited to that kind of sensor, but when we choose a sensor, we must follow the following principles:

(1) Sensitivity

Sensitivity is an important factor in selecting a sensor. It represents the degree to which a change in the unit quantity of the measured object causes a regular change in the response of the sensor. Therefore, when the sensitivity becomes larger, the sensor that represents the weak change of the measurement can also be identified regularly. What we should pay attention to is that when the sensitivity is too high, there may be other signals mixed in, which will bring unnecessary trouble to the post-data processing [13]. Therefore, when selecting a sensor with high sensitivity, the sensor must have a high signal-to-noise ratio to reduce the influence of other signals from the outside world.

(2) Dynamic range

The dynamic range is the range that the sensor can measure, also called the linear range. It refers to the range where the input quantity is proportional to the output quantity while the sensitivity is kept within the given error range. When the dynamic range of the sensor becomes wider, its range also becomes wider, and the accuracy of the measurement can be guaranteed within its range.

(3) Stability

In the case of a special use environment, stability is an important indicator for selecting a sensor. After all, the sensor that can stand the test of time is the sensor that users want. The stability of the sensor can be reflected in the manufacturing details, materials, and sealing properties [14]. Therefore, before choosing a sensor, you must first understand the use environment, and then choose a sensor that is suitable for the environment and has good stability.

(4) Precision

The accuracy is actually related to the price of the sensor. The price of a sensor with high accuracy is usually higher, and the price of a sensor with lower accuracy is more popular. Therefore, when choosing a sensor that is cost-effective and can meet your needs, you can buy it.

(5) Choose sensors according to usage scenarios and needs

When there are more sensors to be measured, we should choose the most suitable sensor according to the sensor's measurement principle. For example, the soil temperature sensor and the air temperature measurement principle are different, and they cannot be mixed [15]. When the market's sensors cannot meet the demand, or the price is higher than expected, we can develop our own sensors to meet the measurement needs.

2.3 SOM Algorithm

The self-organizing feature mapping algorithm adopts a self-adaptive learning and training method without a tutor. Its training principle and basis conform to a certain law of human beings from knowing, understanding, and knowing things that they don't understand. Specifically, it can simulate the cognitive process of human to understand the method of sending seeds. The human knowledge of things rises from perceptual knowledge to rational knowledge. Perceptual cognition is the direct contact with the outside world through the senses from continuous practice, which produces many feelings. The impression of these sensations in the human brain is constantly deepening; rational knowledge is the discovery of the objective laws and essence of things through brain thinking on the basis of perceptual knowledge. The self-organizing mapping method also first input the sample to get the perceptual understanding of the sample space topology, and discover the similarities and different objective laws of things in continuous training, and then rise to the rational understanding. Because this method conforms to the law of human understanding of things, it is often applied in the fields of image recognition, speech recognition and classification.

The basic structure of SOM neural network is mainly composed of input layer and competition layer. The input layer is equivalent to the human perceptual recognition stage. First input samples for basic processing, and then conduct the contact and processed samples to the competitive layer. In the competitive layer, the rational recognition stage is carried out, and the objective laws of the samples are discovered to achieve the purpose of identification and classification .

Like the traditional clustering algorithm, the SOM algorithm also uses the similarity between objects as the basis to divide the samples. The similarity of samples in the SOM algorithm is usually measured by Euclidean distance and cosine method:

$$\frac{a^2R}{at^2}=b_o^2\left[1+\frac{w''}{w'}\frac{au}{ad}+\ldots\right]\frac{a^2R}{ad^2} \quad (1)$$

Standardizing the samples in the Euclidean distance can be obtained:

$$\eta_2=-\frac{w''}{2w'} \quad (2)$$

Motion equation variant:

$$R=R_1\cos(qx-wd)-\frac{1}{4}\eta_2q^2R_2x\sin 2(qx-wd)+\ldots \quad (3)$$

The relationship between R2 and R3 can be obtained:

$$R_2=(\eta_2/4)d^2R_1^2x \quad (4)$$

$$R_3=(\eta_2^2/8)d^4R_1^3x^2 \quad (5)$$

The neighborhood is built around the best matching neuron of the input data x, that is, the current neuron c is the best matching neuron:

$$|x-w_c|=\min\{|x-w_i|\} (6)$$

This update process (in the discrete time concept) can be considered as

$$w_i(t+1)\begin{cases} w_i(t)+a(t)[x(t)-w_i(t)] \\ w_i(t) \end{cases} (7)$$

When using the equal distribution strategy, the expression of this statistic is as follows:

$$S(m,N,r,t)=\frac{1}{t}\sum_{s=1}^{t}\left[C_s\left(m,\frac{N}{t},r,t\right)-C_s^m\left(1,\frac{N}{t},r,t\right)\right] (8)$$

After selecting the maximum and minimum radius, the error between the two can be defined as follows:

$$\Delta S(m,t)=\max(S(m,r,t))-\min(S(m,r,t)) (9)$$

According to the BDS statistical theory, the three equations can be calculated as follows:

$$\bar{S}(t)=\frac{1}{16}\sum_{m=2}^{5}\sum_{i=1}^{4}S(m,r_i,t) (10)$$

$$\Delta\bar{S}(t)=\frac{1}{4}\sum_{m=2}^{5}\Delta S(m,t) (11)$$

$$S_{cor}(t)=\Delta\bar{S}(t)+\left|\bar{S}(t)\right| (12)$$

Simply put, the learning process of the self-organizing mapping algorithm (the process of updating the weight vector) is to find the best matching neuron based on the relationship between the calculated neuron weight and the input data, and then build around the best matching neuron A topological neighborhood, and adjust the weights of all neurons in the neighborhood to make it more similar to the input data.

3 Information Monitoring System Experiment of Internet of Things and SOM Algorithm

3.1 Neuron Initialization And Training

Usually the data sets that need to be processed are relatively large data sets. In order to facilitate the display and make the visualization effect easy to observe, according to the experience described above, the number of neurons in the self-organizing mapping network cannot be too large, so the number of neurons cannot be The square root value that is exactly equal to the number of data in the data set is 5 times the number of data. Arrange the set number of neurons in the form of a two-dimensional grid and fix their positions. Each neuron has the same number of attributes or components as the data, which is called dimension here. The initial value of each neuron is a random value between [0,1].

3.2 Hardware Design of Network Monitoring Node

The terminal data acquisition node consists of: the main control module CC2530, radio frequency module, DS18B20 temperature and current sensor module, and relay control module. For electrical faults, most of the electrical equipment current increase and temperature increase, so the current and temperature parameters are selected for detection in this paper. Among them, the temperature and current sensor module collects the signal, and sends the information through ZigBee networking to the coordinator main control module CC2530 for processing. The data packet is then uploaded to the gateway till the user interface by the main control module.

3.3 Design of Zigbee Gateway Node Hardware

Starting with the fact that the benefits of these two very different wireless network transmission technologies—the 4G wireless network and ZigBee networking—are highly noticeable, one can choose between them. While 4G can provide high-quality data over great distances, ZigBee can network quickly, efficiently, and on a vast scale. These two network types are challenging to combine in a single architecture. To provide barrier-free data transfer across the two different network modes, three processes—data packet encapsulation, data analysis, and re-packet encapsulation—must be carried out during the network transmission process of the collected data packets in the two different data formats.

4 Experimental Analysis of the Information Monitoring System of the Internet of Things and SOM Algorithm

4.1 Information Monitoring in Recent Years

We have recently acquired knowledge about the city, gathered data through official records and statistics, put pertinent data into the model, and digitized it for simple comprehension. Table 1 displays specific data:

Table 1. Information monitoring

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Intelligent monitoring	3.96	4.3	4.3	4.38	4.19	3.94	4.02	4.43	3.77	4.24
Speed	4.32	4.69	4.21	4.52	4.53	4.64	4.69	4.37	4.47	4.43
problem solved	4.92	5.15	4.81	5.31	5.01	4.96	4.7	4.98	5.04	5.24
Energy saving optimization	5.25	5.81	5.17	5.11	5.96	5.42	5.83	5.58	5.91	5.74
Operation Management	5.76	5.9	5.81	6.08	6.07	6.08	6.2	6.5	6.47	6.51

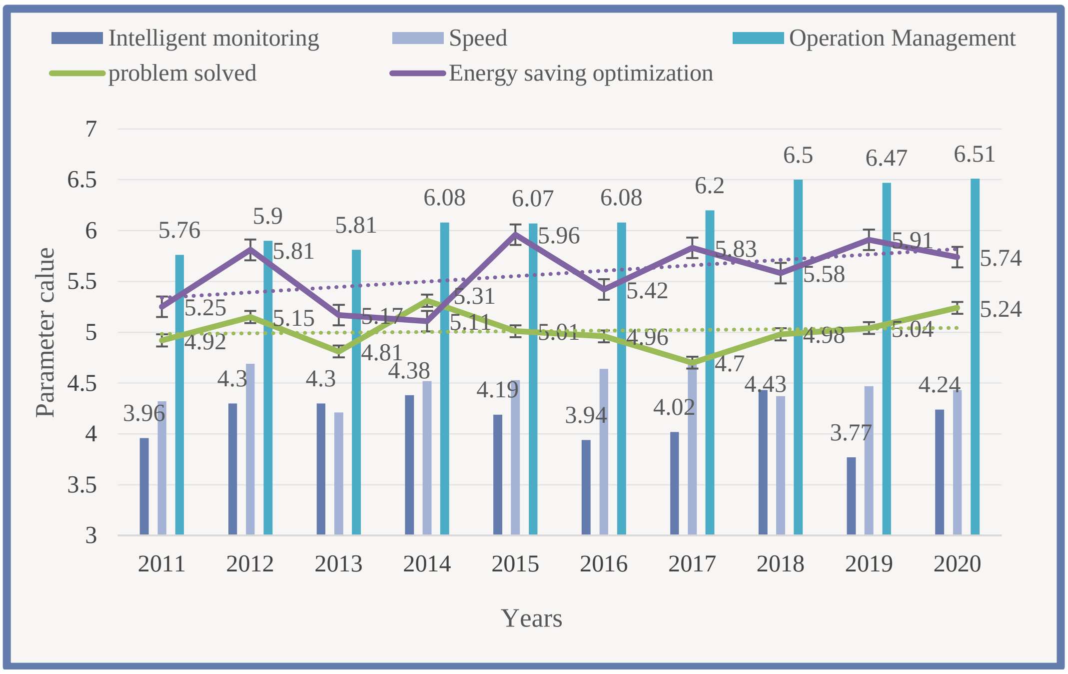

Figure 1. Information monitoring status

Figure 1 demonstrates that, despite a few detours in recent years, the overall degree of information monitoring has formed an upward trend. 6.51 in 2020, up from 5.76 in 2011, the employment management score increased by around 13%. Small-problem solving skills and energy-saving optimization in general have not changed significantly. We calculated the varying trend of monitoring data over the last five years, as shown in Table 2:

Table 2. Trends in information monitoring

	2016	2017	2018	2019	2020
Intelligent monitoring	-0.24	0.17	0.14	-0.26	0.46
Speed	0.189	0.195	0.199	0.212	0.259
problem solved	0.206	0.199	0.215	0.218	0.323
Energy saving optimization	0.25	0.22	0.21	0.18	0.29
Operation Management	0.21	0.24	0.39	0.15	0.16

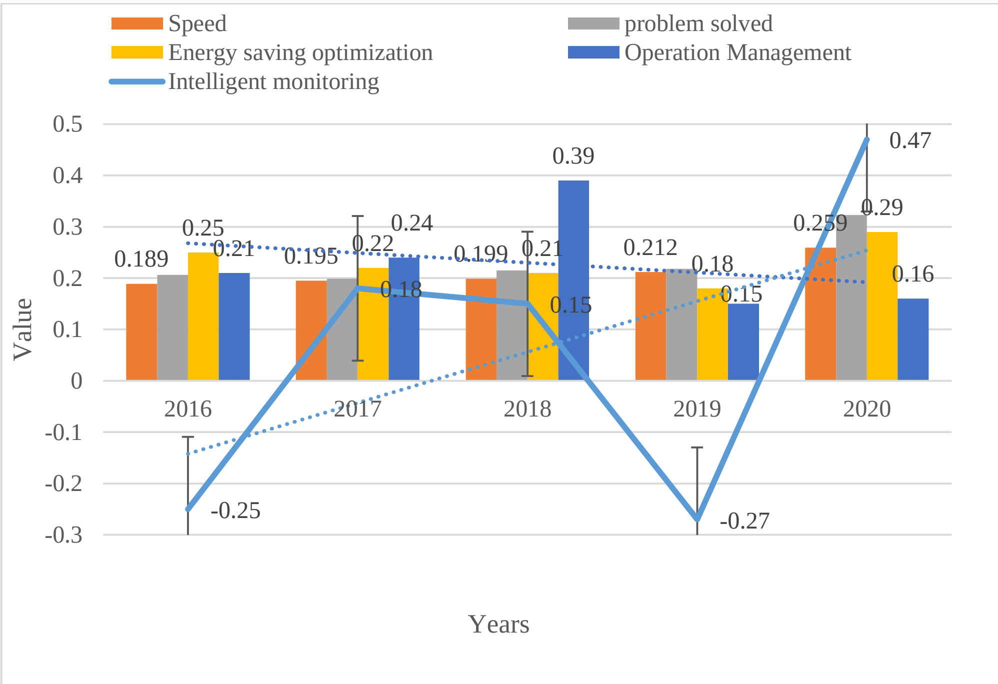

Figure 2. Information monitoring changes

Figure 2 demonstrates that control has increased and has continued to grow over the past five years amid a culture of regime transition. Although there were some modifications in terms of performance and control, the overall change culture remained unchanged.

4.2 Artificial Intelligence in Social Governance

By comparing two businesses of same size and reading the changes in monitoring data following the installation of the Internet of Things and SOM algorithms, as shown in Table 3, we compared two businesses of equal size:

Table 3. Traditional information monitoring

	2016	2017	2018	2019	2020
articulation	0.278	0.239	0.267	0.259	0.265
transportation	0.301	0.261	0.275	0.283	0.329
Accuracy	0.327	0.357	0.372	0.369	0.374
general affairs	0.401	0.366	0.418	0.389	0.417
operate	0.418	0.427	0.437	0.448	0.453
expense	0.462	0.482	0.506	0.516	0.522

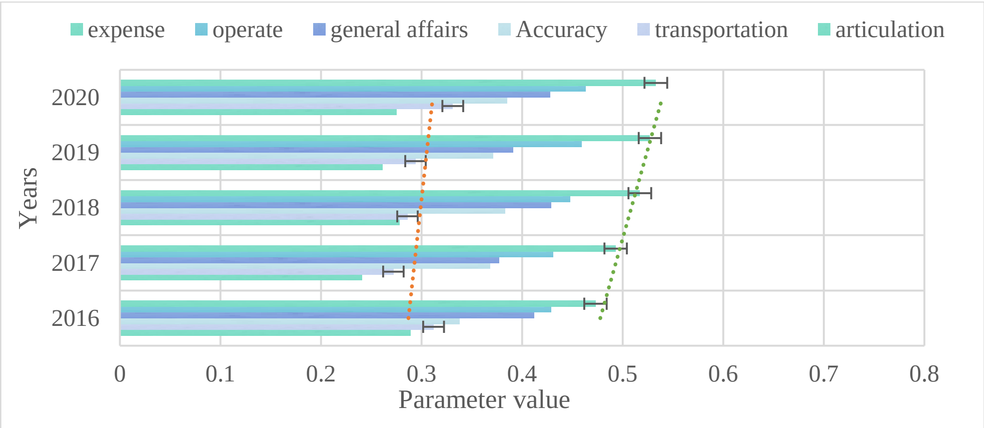

Figure 3. Traditional information monitoring changes

Figure 3 shows how traditional management systems are progressing with time, creating greater standards in government, and bringing about certain consequences in terms of operate and articulation, but the average change is not significant. Additionally, the price of social operate has gone up recently, despite an increase in revenue of about 10% over the previous five years. The SOM technique was used to run statistics on the things presented on the Internet, as shown in Table 4:

Table 4. Internet of Things and SOM algorithm changes

	2016	2017	2018	2019	2020
articulation	0.401	0.432	0.425	0.447	0.436
transportation	0.458	0.464	0.463	0.456	0.481
Accuracy	0.498	0.483	0.512	0.496	0.526
general affairs	0.541	0.569	0.556	0.548	0.570
operate	0.611	0.587	0.598	0.621	0.649
expense	0.295	0.293	0.303	0.314	0.326

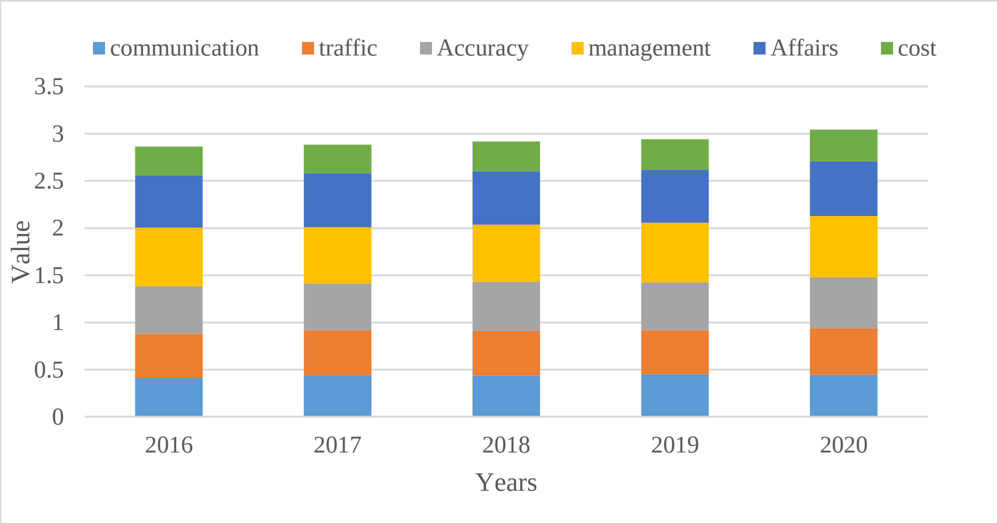

Figure 4. Internet of Things and SOM algorithm change trends

As shown in Figure 4, we can see that in terms of information monitoring rules, Internet of Things and SOM algorithms have great advantages for traditional control systems, with more than 40% more than traditional control systems in normalcy, control, and communication rules. . Additionally, the cost of monitoring information has significantly decreased as a result of the adoption of Internet Monitoring Objects. The sluggish and expensive human monitoring that is a major component of traditional approaches. However, expenses have decreased by about 30% as a result of the Internet of Things and the SOM algorithm, and efficiency has also been demonstrated.

4.3 Investigation of Different Monitoring Methods

People must test out different monitoring techniques in real-world settings. As indicated in Table 5, we conduct questionnaire surveys to ascertain how well people comprehend various monitoring techniques.

Table 5. People understand

	Unknowable	Technical rationality	Social rationality	Liability risk	Data acceptance	Data Display
Don't understand	24	28	32	36	41	20
Understand some	10	12	16	29	32	34
General understanding	20	24	18	30	34	36
Know very well	20	16	12	17	21	12
proficient	6	10	8	7	12	14

We can see from Table 5 that one does not clearly understand the different monitoring methods. Most people simply have uncertainty and do not understand the possible responsibilities and technical circumstances of monitoring information. This is also because monitoring information is only visible for a moment, and people don't understand it. In order to play a role in the management of the company, we also interviewed experts and performed calculations in related methods, as shown in Figure 5:

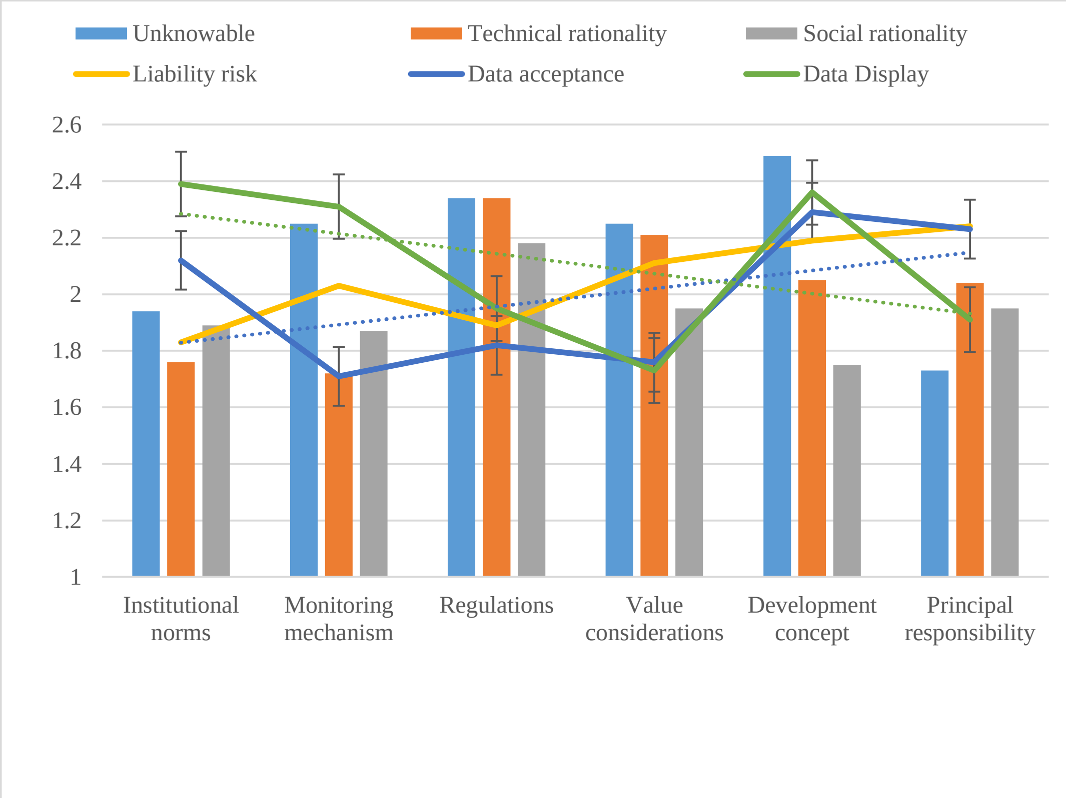

Figure 5. IoT information monitoring situation

As show in Figure 5, we can see that in terms of information monitoring, the development of a data analytics module in an Internet -based intelligent monitoring system can effectively change the role of the team's production management department from selection. of production data, managers to analyze and decision maker production data, improve the performance and control level of sewage treatment plants. Collecting data and analytics work that may have taken a lot of time in the beginning can shorten working time on operating an intelligent monitoring system, improve production efficiency, and improve data efficiency and decision-making capabilities. .

5 Conclusion

By deploying multi-layer home temperature sensors such as, for example, data collection and transfer processes, as well as registration, access, binding, and viewing services on the IoT cloud platform, it is tested. In parallel, software and application development for the Internet of Things is ongoing. The program uses the system to compile and analyze basic data, and eventually presents it in the form of a large data display. Through research on data acquisition of Internet of Things -based intelligence monitoring system, the data acquisition process of Internet -based intelligence monitoring system in this study has emerged from two aspects of intelligent data entry processing. System monitoring, which provides for increasing the volume of system data.

This article uses multi-layer temperature sensors as an example to show the process of data collecting, data transfer, and presentation of the IoT cloud platform. It essentially describes the design and execution of an Internet-based monitoring system of Object technology. The goal is to design and develop monitoring systems including data collection, data transfer and data display of IoT cloud platforms, which can provide reliable monitoring systems for routine monitoring, and provide data services for intelligent management of production processes through artificial intelligence and others. euy ero.

Although this article has designed information and research about relevant content that is part of Internet-based information monitoring system Technology matters, system development and design with many technologies, More monitoring objects, more research content, powerful comprehensive type, and experimental conditions and personal capabilities are limited, and there are still many areas that need to be improved, and more research available is needed. They are summarized specifically in these areas: (1) In the case of data collection, it is necessary to develop or purchase other sensors to collect field information together. In addition, many parameter validations and testing of battery control modules were performed on the development sensors. (2) In the case of data transfer, it is necessary to test the reliability, accuracy and loss rate of data packets in short data transmission and long distance data transfer.

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