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Industrial IoT Mining Algorithm of Cloud Computing Research

Du Yuan-sheng [1] and Yun Zhi-chao [2]

12(ShangDong Vocational College of Science and Technology,WeiFang, ShanDong Province)
sdfyduys@126.com;yunzhichao@126.com

Abstract

IoT*industry due to the equipment, product distribution, a large number of sensors, the various types of data collection, through the server on the Internet, but in data and management data to be obtained, with the popularity of mobile terminal, often need to pass the mobile Internet, mobile terminal for data processing and management, in the light of the mobile Internet Internet data management characteristics, depth of the proposed neural network data mining algorithm, can effectively improve the efficiency of cloud computing.*

Keywords: *industrial Internet of things; cloud computing; data mining; the depth of the neural network; data to predict*

1. Introduction

Industrial IoT communication [1] is based on a variety of equipment and products by different heterogeneous network access to the Internet, making various kinds of equipment and products of information gathering to the Internet, so as to realize the online monitoring and management. In the fifth generation of mobile communication, on the basis of the heterogeneous network devices on the network (Device to Device, D2D)[2-4], provides a physical basis for industrial iot. The traditional wireless sensor network (WSN), just for a key node in large equipment acquisition related physical quantities information, according to the quantity of different position sensor information to forecast and monitoring equipment failure condition. Yet such limitations of wireless sensor network has very strong, the limitation of region is larger, and can detect the same equipment, only do not have the function of joint detection; If, however, will all nodes of wireless sensor network can be connected into the mobile Internet, Internet of things system, can detect multiple online equipment operation performance, found a chain reaction of failures in a timely manner, and at the same time, also can to multiple joint by means of a large amount of data processing, data mining, to predict failure data, so as to prevent the happening of the fault. Items can also be based on Internet access and transfer to the site can get logistics transportation, as well as the rational allocation of the transportation, so, based on the D2D iot technology in industrial production, transportation and industrial consumption has been widely used, all aspects is the beneficial guarantee industry achieve 4.0 times and important basis, so the application in academia and industry became a hot issue of research.

Industrial iot communication is based on a variety of equipment and products by different heterogeneous network access to the Internet, making various kinds of equipment and products of information gathering to the Internet, so as to realize the online monitoring and management. In the fifth generation of mobile communication, on the basis of the heterogeneous network devices on the network (Device to Device, D2D), provides a physical basis for industrial iot. The traditional wireless sensor network (WSN), just for a key node in large equipment acquisition related physical quantities information, according to the quantity of different position sensor information to forecast and monitoring equipment failure condition. Yet such limitations of wireless sensor network

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has very strong, the limitation of region is larger, and can detect the same equipment, only do not have the function of joint detection; However, if the wireless sensor network (WSN), however, the development and research of Internet of things is mainly focus on the realization of the physical and information transmission, especially on the basis of RFID on the positioning problem of RFID on the basis of the physical positioning problem now already has the very good performance, that is the physical location can provide better location information for the upper, and need for application of geography information, can need not pay attention to the positioning problem. And then the research to the physical transmission problems, such as adaptive modulation coding technique, channel coding technology as well as the cognitive radio technology, the technology research main goal is to transmit the information of how to effectively accurate transmission to the destination node. With the development of the wireless physical layer technology, has been able to realize high transmission of point to point, based on the D2D industrial iot technology also for application in the fifth generation mobile communication system, so that they can more efficient to transfer the required data. However in these studies are based on the area of the lower, not to the implementation of the main research direction is concentrated in the upper studies, only part of the research in application layer security, for can access the Internet of things the node authentication problem, is a direction of the research. However, to realize the function of industrial iot need to analyze the data of the Internet of things, only to the thorough analysis of data, can be according to the conclusions obtained from different to the operation of the subsequent industrial iot for scientific decision-making. Scientific decision is derived from the data analysis of the industrial iot, namely, large data analysis, in big data analysis, however, requires a lot of computational problems, on the industry of Internet of things, how to schedule computational resources, meet the needs of different computing resources, this would require the application of cloud computing method, but the cloud computing resource allocation problem and computing can satisfy the service quality of the business, after all is the need to study the subject, in dealing with good computational resources allocation problem, however, how to do data mining, so as to realize the prediction of the data, also needs in-depth study, therefore, need to study a data mining method is suitable for industrial IoT characteristics, the traditional neural network, genetic algorithm and ant colony algorithm is a variety of methods can't adapt to the characteristics of the large industrial IoT data. According to this problem, this paper studied from two aspects: first, according to the features of the topology of the industrial iot and the characteristics of each node limited power, cloud computing is proposed based on the energy consumption efficiency of computing resource allocation methods; Second, research a data mining method based on the depth of neural network, this method can adopt the way of self learning, build the structure of data mining, so as to realize the efficient algorithms of data mining[5-7].

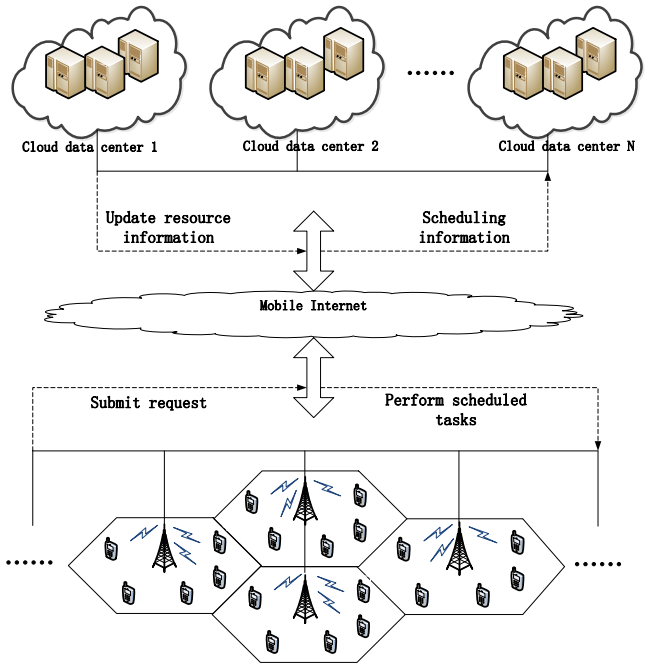

Figure 1. Industrial Networking Topology

As shown in figure 1, the topology of the industrial IoT, industrial IoT from general structure for can have industrial sensors, mobile Internet network and information processing platform. Among them, industrial sensors, and the mobile Internet for information processing platform to provide the basis of the hardware, and information processing platform to provide users with a rich variety of services. The user can through the information processing platform to get the data of the mobile Internet services. Content LianWangHua make industrial control system function more, use more flexible and better performance at the same time, the system complexity and openness brings system vulnerability, reduce the reliability of the system to use. At present, the industrial control system based on iot architecture is widely used in electric power, petroleum, chemical industry, sewage treatment, water conservancy, transportation, pharmaceutical and large manufacturing industries, according to incomplete statistics, more than 80% in key infrastructure of national economy and people's livelihood depend on industrial control system to realize automatic operation, industrial control system is an important part of national security strategy. Intrusion detection incidents in the industrial control system in recent years, according to authoritative industrial safety event information base as the statistics, by the end of 2011, the world has more than 200 attacks on ICS incidents, which brings the problems such as paralysis, generating equipment damage public facilities, endanger people's life and property security, to carry out the industrial control system of the user behavior research has very important strategic significance. Industrial control system usually refers to the support of industrial control network and system, including data acquisition and control testing system, the distributed control system, process control system, programmable logic controller and the fieldbus control system, *etc*., has been widely used in industry, energy, transportation and municipal industry, *etc*, involved in electric power, water conservancy, metallurgy, petrochemical, nuclear energy, transportation, pharmaceutical, heating water supply of cities and large manufacturing industries. With the development of computer and network technology, especially information technology and industrialization depth integration and the rapid development of Internet of things, are used more and more industrial control system general agreement, general hardware and general software, connected to the Internet or other public network

through various ways. The industrial control system based on Internet of things is widely used in various fields.

2. Related Works

2.1 Industrial IoT Research Present Situation

University of duisburg, Germany, designed a kind of application in the industrial automation of fault-tolerant wireless network control system, the goal is to obtain a communication protocol, control, and the integration of parametric fault diagnosis algorithm and design, to meet the needs of industrial application of high real time capability. France will FPGAs applied in industry control system, FPGAs in complex application system for sensor motor controller, this controller based on extended kalman filter, this paper described based on the use of artificial intelligent controller, put forward the design method of neural network control system for FPGAs. And to develop a kind of intelligent transportation system with multi-stage user interface, used to detect vehicle running state, the system can provide different levels according to different level user operation interface provides the corresponding detection information; Italy's national research council institute of atmospheric pollution f. Costabile research such as a traffic exhaust emission status and establish a direct connection between the air quality, the method of using intelligent transportation motor vehicle air pollution detection platform for real-time traffic exhaust emission status and air quality condition, record emissions data and pollutant concentration, through mathematical modeling direct correlation between two data; Bagel already - Ho, a smart home platform, the platform with a carrying function of RFID and sensor intelligent household facilities, a central server and the integration of wireless sensor intelligent robot; And introduces a kind of intelligent building internal ring orientation detection system, system based on magnetic force of non-contact sensor networks provide building indoor positioning, communications and power transmission function research[8-9].

Macro perspective focuses on the Internet of things system is an integral part of summed up in a macroscopic description of the Internet of things system. Internet of things mainly has three parts: the network terminal sections, transmission network, data processing center (application layer). Network terminal part refers to the sensor, also known as acquisition front, this is a final data source of Internet of things, this is also the perception of the Internet of things layer, is induced by sensors or different external signal to realize data acquisition, processing, conversion, signal into people's needs, in most cases is the electrical signal. Later, on the basis of the corresponding relation of the external signals and electrical signals to the corresponding data processing. Here have higher request for the sensor, in different environments, the requirement of the sensor is different according to the practical application, for example, when measuring the PH of the water, with isolation protection, need of sensor in measuring human body blood pressure, ecg and other physiological parameters, need to design protective measures, to prevent damage to the body, *etc*. At the same time, low power consumption, small volume, stable, long life, low price, these are the specific requirements of the network terminal part. The second part is the transmission network part, this part mainly is to assume the role of information transmission, even if the network terminal part of the acquisition of a variety of data through the transmission network for data transmission, transfer from detection to the corresponding management control center. Because there are many different kinds of network terminal, the deployment area form is numerous, so to make the transmission network in various applications to be able to realize the stable and efficient data transmission, just need people to design the high stability coefficient, to interfere with the processing capability is strong, large capacity of transmission network.

The third part is to control the processing center, brings up the front part of the data transmission network part, in the control processing center will categorize these data, integration, on the basis of the purpose of the application of selected data effectively, eliminate abnormal data, according to the corresponding processing algorithms, dealt with as a result, this result in some applications can be transmitted through the reverse communication path, sent to the network terminal part, thus to realize the control center a two-way communication with the whole network. Data processing center is based on the former two parts for work, therefore to fully reference by the scale and characteristics of the former two parts design, can in the practical application of reasonable and efficient control and data processing [10-11].

In actual application of the Internet of things, external disturbance and destruction is inevitable, system recovery is especially important, and in each part of the Internet of things, the transmission network in the whole recovery process, has played a very important role in bridge. Will link up network terminal and control processing center, transfer the data and control information, if the network terminal part of the data can not be transmitted to control processing center, the basic function of the Internet of things cannot be achieved, if control processing center of information will not be able to feedback to network terminal through a transmission network, it can't to the effective management of the terminal, make the advantage of the Internet of things will not be able to effectively play out. Iot of transmission network is the bridge of the entire Internet system, network transmission is the actual data from the network terminal and control processing center sends the control and the result of processing information, which constitute the basis of the Internet of data flow, and the nature of the Internet of things concern. Transmission network of Internet of things in addition to the role of the core, to design and set up to focus on research, in the use of the mass, how to make network built rapidly in a short time, and decide whether or not a iot system the core element of the mass should be practical. In more application scenario, the surrounding environment is complex, will not be able to accurately network deployment, for example in forest inside deployment test environment of the Internet of things, in a complex terrain of large-scale network deployment, deployment will be the special concerns quickly and easily, it will be in the topology of the network and network routing design to be able to adapt to this kind of need.

Internet data center is the "brain" of the Internet of things, in the network to collect information ultimately converge at this point, through corresponding algorithm of judgment, analysis and processing, but in the final processing result is the Internet of things a purpose of the system, the results can help for the decision of human, improve the performance of the relevant inspection situation, intelligent judgment result also can optimize the network routing and adjust the network topology. So this paper mainly analyzes Internet data center, in order to gain access to relevant information, provide strong scientific basis for subsequent decisions

2.2 Cloud Computing Research Status

At the beginning of this decade, the American national standards institute of technology from the perspective of the user experience, divides into the cloud computing service mode laaS (infrastructure as a service), PaaS (platform as a service), SaaS (software as a service). LaaS cloud computing services currently research hotspot for the user how to measure the adoption of cloud computing costs, as well as the service provider how to maximize the use of their own physical resources. Cloud computing infrastructure users hope to be able to meet QOE (Quality of Service, Service Quality assurance) requirements, the premise of minimizing pays fee. So under the mode of laaS, the adoption of cloud computing service cost calculation is extremely important, Dedman

through empirical method to measure the users using the resources of the cloud provider for intensive data applications need to pay cost. In order to help the enterprise measure respectively using cloud computing services and purchase cost of server cluster in both cases, and then make the right investment decisions, which is based on the performance of depreciation developed a model to measure the CPU cost per hour. In terms of cost factors affecting research Gui, Marcos seven scheduling policy method was used to study the cloud computing providers using cloud computing capacity extension cluster, and considering the factors such as the weighted average response time, and then puts forward the extension cluster capacity formula of the cost of calculation, the cost will eventually become part of the cloud computing providers offer, and become the users need to pay the cost. JochenStober pointed out that because the cloud computing can dynamically obtain computing resources and services, so the enterprise can through flexible deployment method to reduce the cost of hardware and software. They use critical ratio pricing and k pricing method and the extensibility and find a suitable match between strategic behavior, and gives the user need to pay the cost of the components. Some scholars began to study the adjustment of cost comparison and pricing mechanism, the cloud computing set up a set of experiment platform contains user application and service content of self-tuning parameters, and found by simulation, the adjustment of pricing mechanism than regular fixed or variable mechanism more can improve the utilization rate of cloud computing infrastructure, so that the user if adopt cloud computing services based on self-tuning pricing mechanism, can make its reduce the cost. For the cloud computing infrastructure providers, providers need to accordance with the requirements of QOE, timely to each application of the optimization of dynamic allocation of adequate basic resources, at the same time, also to meet the overall efficiency of the optimal conditions.

PaaS cloud computing service is one of the main points of the success to make it quickly spread and accepted by users actively. Although both at home and abroad in the research of technology innovation diffusion theory and the technology is mature, but applied research in the field of cloud computing is not enough. For technical innovation diffusion foreign scholars from the market capacity, safe, innovative products, marketing and market characteristics, multifa ceted aspects of macroeconomic conditions on the influencing factors of technology innovation diffusion is studied.

SaaS cloud computing service platform based on Internet media to provide customers with online software applications, while SaaS cloud computing service platform is put many SaaS cloud computing service providers and users together, with the typical bilateral market. Scholars at home and abroad in the study of bilateral market focus on platform architecture and features, pricing model and platform enterprise ownership, *etc*.

3. Proposed Scheme

In this paper, we study the cloud computing scheme based on Internet of things industry, mainly from two aspects to carry on the theoretical design, first of all, based on energy efficiency of industrial iot cloud computing resources allocation problem; Secondly, in view of the industrial structure and characteristics of the network data, design a data mining algorithm based on depth of neural network, this method is able to a large amount of data to predict the adaptive training and mining.

3.1 Computing Resource Allocation Scheme Based on Energy Efficiency

In mobile Internet, n operates a business type need scheduling, as many business types of mobile Internet, so the value n is very big, provides for the business $S_1, \cdots S_n$, and each business type in the need for computing resources r_i, this paper use vector $\boldsymbol{r} = (r_1, r_2, \cdots, r_n)$ said n different business computing resources. Set in the mobile Internet can be divided into m classes, mobilize the computing resources of every kind of computing functions

with said c_i, as the calculation of normalized function c_i, therefore $c_1 = 1$; The virtual machine can be expressed in vector $\mathbf{C} = (c_1, c_2, \cdots, c_m)$ class m of computing power, because for the normalized type c_1, so the vector $\mathbf{C}$ can be regarded as the proportion of computing power. For example, if the cloud computing service provider of mobile Internet can provide 4 kinds of computing capacity of the virtual machine, respectively, c_1、c_2、c_3 and c_4; Among them, c_1 can stimulate computing resources for the processing of 1 GHZ frequency, calls 2 Gb memory and 500 Gbhard drive; c_2 computing resources at the same time for the processing of dual-core 1 GHZ frequency, call 4 Gb of memory and 1 TB hard disk; c_3 computing resources for the processing of quad-core 1 GHZ frequency, calls 8 gb of memory and 2 TB hard drive; c_4 to eight nuclear 1 GHZ frequency, call 16 gb of memory and 4 TB hard disk; Vector $\mathbf{C} = (1,2,3,4)$ for the reason of computing resources ability. If the mobile Internet cloud computing services to provide the number of the i class for all kinds of the virtual machine to provide the number l_i of the vector $\mathbf{L} = (l_1, l_2, \cdots, l_m)^T$, it should satisfy the conditions for

$$\mathbf{CL} \le M \quad (1)$$

The M representative can provide all kinds of calculate the total number of business. In this part, the main consideration $T = \{t_1, t_2, \cdots, t_n\}$ for the need to deal with the set of all the tasks; Consideration t_i and t_j to deal with the processing of data exchanged between the exchange of data d_{ij}, through the channel of the maximum mutual information can be expressed as i_{ij}, set up the i a virtual machine for the total computing ability p_i, the time needed to complete this task can be expressed as type (2)

$$T_{l_i} = d_{ij} \Big/ \left(P_i * \rho_{l_i} \right) \quad (2)$$

Which ρ_{l_i} represents the task node capacity from now on. But because of the limitation of bandwidth to consider node transmit information transmission time T_{cl_i}, set the transmission time T_{z_i} for (including after treatment before transmission time and transfer time), so the time for the total completion of the business. According to the virtual machine for computing services, and set each virtual machine need to consume energy E_{l_i} for computing services computing unit, as a result of the transmission system, based on the system of the network, the energy E_{cl_i} needed to power a need data transmission unit (including the energy needed to uplink and downlink data), which can get the energy for the transmission

$$E_{zl_i} = E_{cl_i} d_{ij} + E_{l_i} t_1 \quad (3)$$

Among them, the energy E_Z consumed by all the tasks, can by type (4)

$$E_Z = \sum_{i=1}^{M} E_{l_i} \quad (4)$$

According to energy consumption problem, this paper put forward the optimization of energy consumption and balance time delay problem, so the following optimization problem is proposed.

$$\begin{aligned} &\min \ E_Z \\ &s.t. \ T_{z_i} \le \eta_i \end{aligned} \quad (5)$$

This paper by the method of improved particle swarm, the energy efficiency of the optimal solution of optimization problem, here, not go into particle swarm optimization (pso) algorithm.

3.2 Based on the Depth of the Neural Network Data Mining Method

When the database is very big, due to the limitation of computing resources and memory, precision linear search (sequence comparison query image and the similarity of all images in the database to retrieve) is not feasible and not necessary. Used to describe the characteristics of the image data hundreds of thousands, so content-based image retrieval is often influenced by the dimension disaster performance is not high. This is an urgent need to a high scalability of retrieval method. Using similarity hash indexing is a promising method, but using a single hash table can't weigh the retrieval accuracy and recall rate. And doha when table method is used to gain a high recall rate at constant retrieval time but low retrieval rate, were not associated with a large number of samples caused inefficient returned to the user. How to enhance the accuracy in doha and table method and keep high recall rate and small retrieval time becomes the key to the doha round of successful application.

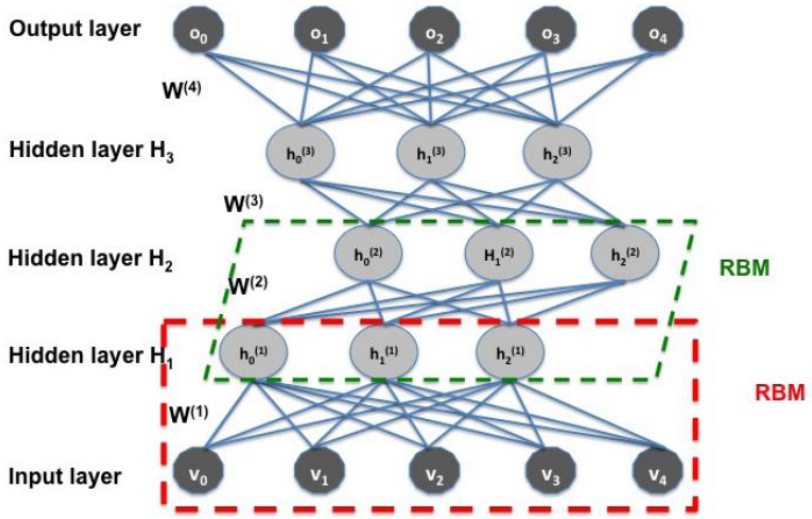

Figure 2. Depth Neural Structures

According to the analysis, according to the analysis of the information theory, the proposed network layer should obey the normal distribution after learning the information should be optimal, the optimal network layer needs to accord with after studying data obey the normal distribution, so the need according to the principle of determination of network layer. Its deep belief network learning model shown in figure 2, according to the normal distribution, can according to the weighted distance as fitting a straight line. Such as type (6)

$$y = \Phi(x) = ax + b \quad (6)$$

Which $\Phi(x)$ represents the cumulative error function of normal distribution.

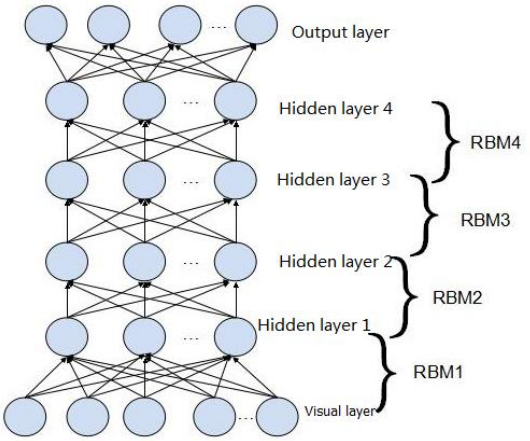

Figure 3. Contains 4 Hidden Layer of Deep Learning Model

According to this method, can be obtained

$$gaurate = \frac{N}{N_{total}} \times 100\% \quad (7)$$

Belief network input, in depth in the input of the past, adopt direct input, but in this way, cause difficulties to the depth of belief network training, so need to be improved. According to the depth of the belief network structure, from the viewpoint of information theory to image features related to calculate the information entropy, such as

$$H = -\int_{-\infty}^{\infty} f(x) \ln f(x) \quad (8)$$

Among them, the characteristics of information entropy can be color, stripe, gray level, such as global content, also can be localized content, according to compare several global and local information, the greatest feature of the information entropy is chosen as the starting characteristics, according to the characteristics of the initial calculation of conditional probability, such as:

$$H(x_1 | x_2) = -\int_{-\infty}^{\infty} f(x_1 | x_2) \ln f(x_1) \quad (9)$$

4. The Experimental Results and Analysis

This paper due to the calculation and simulation of the cloud computing model for the industry of Internet of things, so the need to build a simulation platform of cloud, the cloud model simulation platform for the general CloudSim adopt cloud computing platform, the distributed parallel computing and developed on the basis of, use of the resources of the platform can be through the computer simulation data storage and transmission, but its lack of topology change link, according to the reality, this experiment is modified, the modified according to the topology changes of the transmission of data and transmission time. The simulation environment, including computer configuration environment. The computer simulation environment as shown in table 1.

Table 1. The VM Configuration

	The processor	memory	The hard disk
VM_1	1×2 GHz	4 GHz	500 GB
VM_2	2×2 GHz	8 GHz	1 TB
VM_3	4×2 GHz	16 GHz	2 TB
VM_4	8×2 GHz	32 GHz	4 TB

The course of the simulation is usually shown in the figure below, according to the virtual task and scheduling model, for the development of the core algorithm, the scheduling interval according to different simulation environment, the need to set up separately.

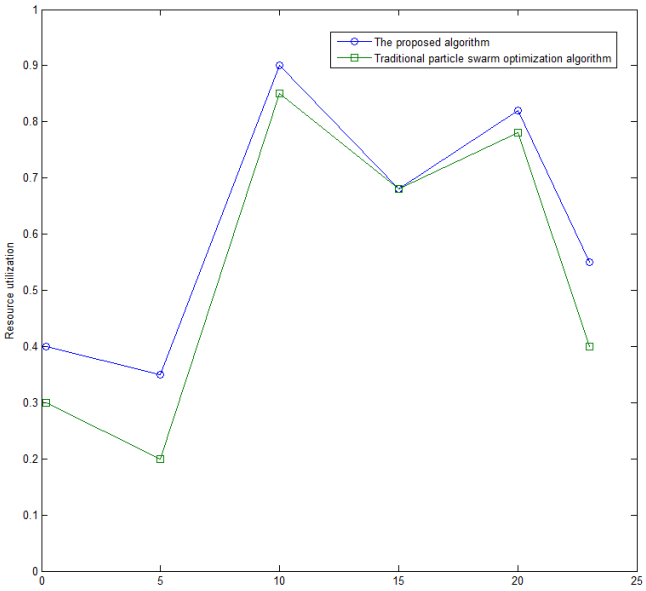

Figure 4. The Utilization Ratio of Resources

Figure 4 can be seen from the resource utilization, resource utilization of the proposed algorithm are significantly higher than other schemes, it can be seen that the proposed scheme can have stronger ability to calculate in terms of business; In order to achieve industrial iot rapid data mining, and industrial iot cloud platforms have been obtained the high efficiency of the application of information mining. It shows that the proposed industrial Internet cloud computing is more efficient.

5. Conclusion

This paper, based on the topological structure of industry of things, such as the limited network node power characteristics, is established based on the YunPing the computing resource allocation scheme, this scheme on the basis of the guarantee time delay, minimize the rate of consumption, thus making the computing resource allocation scheme

is more robust. At the same time, according to the depth of the neural network data mining algorithm to optimize the number of layer, increased the accuracy of the prediction performance.

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Authors

Du Yuan-sheng, He received his B.Eng, M.Eng in Computer Application Technology from Ocean University of China in 1988, 2010. He worked in Huaguang Group Co. Ltd. from 1988 to 2002.He has been worked in the Information Engineering Department of Shandong Vocational College of Science and Technology since 2002.He is currently researching on Data Mining,Cloud Computing.

Yun Zhi-chao, He received his Bachelor of Administration in Information Management from Zhengzhou University in 2004.He received the M.Eng in Computer Application Technology from Ocean University of China in 2009.Since 2004 ,He has been worked in the Information Engineering Department of Shandong Vocational College of Science and Technology. He is currently researching on Cloud computing, Data Mining, Pattern Recognition

