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Construction of enterprise digital service and operation platform based on internet of things technology

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ABSTRACT

The enterprise digital service and operation platform is a national-level platform for operating digital content in the field of standardisation. Based on the national standards for enterprise digital service products, this platform develops a digital product library of standard resource content. The construction of a public operation platform will provide standard digital products and personalised services for individuals and institutional users. The concept of Internet of Things technology is constantly evolving from 'smart earth' in the United States to the 'perceived China' in China. However, no unified definition has been reached thus far. This study examined the construction of enterprise digital service and operation platforms based on the Internet of Things technology. Under the same conditions, the peak value of the data processing efficiency of a single thread in the asynchronous architecture was approximately 4,200 pieces, whereas that in the synchronous architecture was approximately 1,200 pieces. The processing performance of the asynchronous architecture is improved by 320% relative that of the synchronous architecture. As a global dynamic network, the Internet of Things technology can realise intelligent identification, positioning, monitoring, and other functions through specific equipment, sensors, and information processing technologies. It is based on the Internet and has thus been extended and expanded.

Introduction

Amidst globalisation, an increasing number of Chinese manufacturing enterprises have transformed from being product manufacturers to being product−service solution providers to form new competitive advantages. Specifically, these enterprises offer services that relate to the characteristics of their products, from basic maintenance, repair, and training in the use of traditional products to the provision of customer-orientated enterprise digital service systems (Yang et al., 2021). The enterprise digital service and operation platform is a national-level platform for operating digital content in the field of standardisation. Based on national standards for enterprise digital service products, the platform combines standard resources and products to develop a unified digital product processing and service engine and form a standard digital product library of resource content. Through this platform, telecom merchants, for example, charge rental fees based on customer needs or purposes, thereby increasing the efficiency of resource sharing amongst tenants, reducing unnecessary costs for operators, and creating a virtuous ecosystem of remote users, third parties, and operators (Shickh et al., 2022). Enterprise digital services have created new opportunities for manufacturing enterprises and have become a driving force for the service-orientated transformation and advancement of the construction of these enterprises' operation platforms (Magnus et al., 2019; Xu et al., 2018). However, with regard to utilising enterprise digital services for enhanced innovation and competitiveness through operation platform construction, many manufacturing enterprises lack experience and knowledge at the operational and strategic levels (Wang, 2023). Meanwhile, the construction of a public operation platform provides digital products and personalised services with standard resources for individuals and institutional users. Blind investment, construction, and imitation only increase costs and hinder the achievement of expected goals (Bahri & Besbes, 2018).

The concept of Internet of Things is evolving from the 'smart earth' of the United States to China's 'perception of China', but no unified definition has been formulated thus far (Guiping et al., 2022). Nonetheless, an operation platform based on the Internet of Things requires functions such as business acceptance, opening, and billing functions (Li et al., 2017; Wei et al., 2020). Suppliers in the Internet of Things service industry must have a set of specific operation service modes for customers, network sensor merchants, and third-party application providers. These functions should be provided on an operation platform based on the Internet of Things (Yang et al., 2021; Wang et al., 2023). This platform can collect information through the nodes of the network, analyse and store the collected information

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simultaneously, and then calculate the dynamic large-scale data in a large range using the Internet of Things technology (Munín-Doce et al., 2020). Operators need to provide dynamic search services for specific regions, even those that are small in size but generate massive data, which will challenge all aspects of the Internet of Things-based operation platform (Lv & Li, 2021; Strangio et al., 2016).

With the development of the economy and society and amidst globalisation, countries worldwide have paid close attention to the role of the Internet of Things in promoting economic development. With this technology, countries initiate their own advantageous projects and then extend them to other undertakings (Maxim et al., 2018). The construction of enterprise digital service and operation platforms based on the Internet of Things technology, understanding the role of digital resources in the service transformation of manufacturing enterprises from a strategic perspective, and clarifying the strategic value of digital resources are important for manufacturing enterprises to grasp the correct direction of digitally driven service transformation and decide to construct an enterprise digital service and operation platform for service innovation (Ahmed & Kumar, 2017). The standard digital content operation platform is a national-level platform for operating digital content in the field of standardisation. Based on national standards for digital products, this platform combines standard resources and products with Internet of Things technology to develop a unified digital product processing and service engine and form a standard digital product library of resource content. Through public cloud service platforms based on the Internet of Things technology, the standard digital content operation platform provides digital products and personalised services with standard resources for individuals and institutional users. The Internet of Things, as a global dynamic network, can link anyone and anything, anytime and anywhere, through information sharing using specific equipment sensors and information processing technology. Thus, the Internet of Things technology can realise intelligent identification, positioning, monitoring, and other functions. This technology has also been extended and expanded (Puliafito et al., 2019).

This study offers the following contributions:

(1) This study presents a functional architecture diagram of an operation support platform based on the Internet of Things. The operation support platform connects all objects to the Internet for information exchange. Common information sensing devices include radio-frequency identifiers, laser scanners, infrared sensors, and global positioning systems, which can identify, analyse, locate, track, and control objects.

(2) This study compares the performance of different threads. Based on the characteristics of cloud computing and the Internet of Things, the study also constructs the proposed operating platform and maximises the advantages of cloud computing. Building the platform requires the assembly of the cloud infrastructure, which comprises three parts: network requirements, physical information resources, and virtual storage pool.

The remainder of this paper is structured as follows: Chapter 1 describes the background and significance of enterprise digital service and operation platforms and then introduces the main study. Chapter 2 introduces the related studies on enterprise digital service and operation platforms. Chapter 3 introduces the principles and algorithms of the Internet of Things technology. Chapter 4 discusses the construction of the enterprise digital service and operation platform, the simulation experiments, and the results. Finally, Chapter 5 provides a summary of the study.

Related works

This section discusses the current literature on enterprise digital service and operation platforms based on the Internet of Things technology. Matsumoto et al., and Takeda (2017) reported the construction of an enterprise digital service and operation platform as an industry-level digital content operation platform project approved by the State Administration of Press, Publication, Radio, Film, and Television. Based on the technical capacity transformation of enterprise digital service transformation and upgrading projects and the construction of a standard professional resource database, standard resources are deeply excavated, classified, and reorganised whilst Internet technology and information are used to form digital products with rich content and various forms. Jia et al., and Mandoh (2018) explained that using big data analysis, enterprise digital services can provide the service function of operation platforms, and standard information service enterprises can establish their operation platform systems. Jiang et al., and Zhou (2012) showed that enterprise digital services are national digital content operation platforms in the field of standardisation. They combine standard resources and products to develop a unified digital product processing and service engine and form a digital product library of standard resources. Through the a public cloud service platform, individual and institutional users can access standard resources provided by digital products and personalised services.

Xu and Sun (2021) proposed that the traditional operation platform construction and development mode often adopts centralised management with simple and direct development, low system development efficiency, difficult code maintenance, inflexible deployment, and low system stability and scalability. Meanwhile, the development of microservice cloud platforms adopts a distributed system architecture and involves specialised development based on business requirements. The resulting system thus exhibits high stability, expansibility, and strong maintainability. Iwendi et al. (2021) used big data analysis to construct an enterprise digital service featuring a network service portal and digital reading service. Portal services include standard information retrieval, query, and purchase based on the Internet; and e-mail notification, customer relationship management, and other systems. Through the portal, the service offers mobile, local area network (LAN), and other users with a digital library, full-text database reading function, and so on. Tyagi (2019) showed that in the era of enterprise digital services, the connections between enterprises, suppliers, and users are largely based on networks. The effective construction of operation platforms can realise the rapid flow of resources. As a dynamic industrial network, a value network requires a rapid flow of resources for efficient operation.

He et al., and Zheng (2018) emphasized that relevant standards and norms of the construction of enterprise digital service and operation platforms should be formulated, a processing and production centre of enterprise digital service and operation platforms' service cloud should be built, and the standard resources in these platforms should be processed and produced through a unified product and service production engine. They also explained the need to create a standard digital product promotion platform to classify, sell, and serve various standard resource products, such as interactive e-books, applications, and featured databases Through big data analysis, Cao et al. (2006) provided portal services such as standard information retrieval, enquiry, and purchase based on the Internet; and support systems such as e-mail notifications and customer relationship management. These services and systems provide mobile and LAN users with a digital library and full-text database reading. In terms of resource services, operation platforms provide knowledge-based collaborative services for service sites and direct users, and users can acquire resource content through service channels, such as knowledge communities.

Castelli et al., and Vitt (2021) showed that this platform provides enterprise digital service functions and that standard information service enterprises can establish operation platform systems through this platform. On the one hand, the platform can provide services for users through public portals; on the other hand, it can provide standard resources, digital products, and information knowledge services with industry characteristics through its management function. The present study examines the construction of enterprise digital service and operation platforms based on the Internet of Things technology. Building such platforms require investment by relevant enterprise departments. Depending on the situation, customer needs, and cloud computing requirements, they must buy and install these platforms repeatedly, maximise the benefits of cloud computing, and build a scientific and reasonable Internet of Things-based platform. Through virtual technology, cloud platforms attract multiple customers and enable them to enjoy resource sharing. Meanwhile, telecom operators charge rental fees according to customers' needs or purposes, thereby increasing the efficiency of resource sharing, reducing the unnecessary costs of operators, and establishing a virtuous ecosystem of far-end users, third parties, and operators. Enterprises maintain competitive and cooperative relationships, with operators who directly obtain funds from users having an advantage in the competition. However, from the perspective of industrial development, telecom operators are in the middle and lower reaches of the competition while software and hardware equipment providers offer technical support for enterprises in the middle and lower reaches. The standard digital content operation platform is a national-level platform for operating digital content in the field of standardisation. Based on national standards for digital products, the platform combines standard resources and products to develop a unified digital product processing and service engine, form a digital product library of standard resource content, and provide personal and institutional users with digital products and personalised services with standard resources through public cloud service platforms.

Principles and algorithms of Internet of Things technology

The Internet of Things refers to the use of information sensors to connect everything to the Internet according to certain protocols and to exchange information. Common information sensing devices include radio-frequency identifiers, laser scanners, infrared sensors, and global positioning systems that can analyse, locate, track, and control objects. The Internet of Things technology platform is rooted in standard digital content resources and digital products and utilises the established professional knowledge base of standard resources and front-end digital processing and production tools to carry out management, publishing, and operational activities. Upper-level business systems exchange data with the data resource base. The Internet of Things is a network centred on the Internet and is a derivative product of the Internet. It expands the function of the Internet from information communication to information sharing between objects. The Internet of Things has a broad field and scope, including information transmission, data analysis, processing, information reception, and occurrence. At present, the application scope of the Internet of Things has been extended to various industries, such as transportation, construction, medical treatment, and production. The standard digital content operation platform is a national-level platform for operating digital content in the field of standardisation. Based on national standards for digital products, this platform combines standard resources and products to develop a unified digital product processing and service engine and form a standard digital product library of resource content. Through public cloud service platforms, the standard digital content operation platform provides digital products and personalised services with standard resources to individual and institutional users. Fig. 1 shows the functional architecture of the Internet of Things operation support platform based on the construction requirements of the Internet of Things operation platform and architecture.

Providers in the Internet of Things service industry must have a specific operational service model that includes customers, network sensor merchants, and third-party application providers. The relevant functions should be provided on the operating platform. Information processing functions are also required. The entire software platform should include four parts: web portal system, core business layer, terminal and application server access layers, and underlying basic components. Processing information includes collecting, storing, analysing, calculating, and displaying. The software platform adopts a hierarchical and modular design that achieves high cohesion and low coupling. The digital service and operation platform uses an established standard resource professional knowledge base and front-end digital processing and production tools to perform a series of management, release, and operational functions. The core logical structure is illustrated in Fig. 2.

In the clustering scheduling system for real-time task transmission of the Internet of Things, multisource information is assigned to

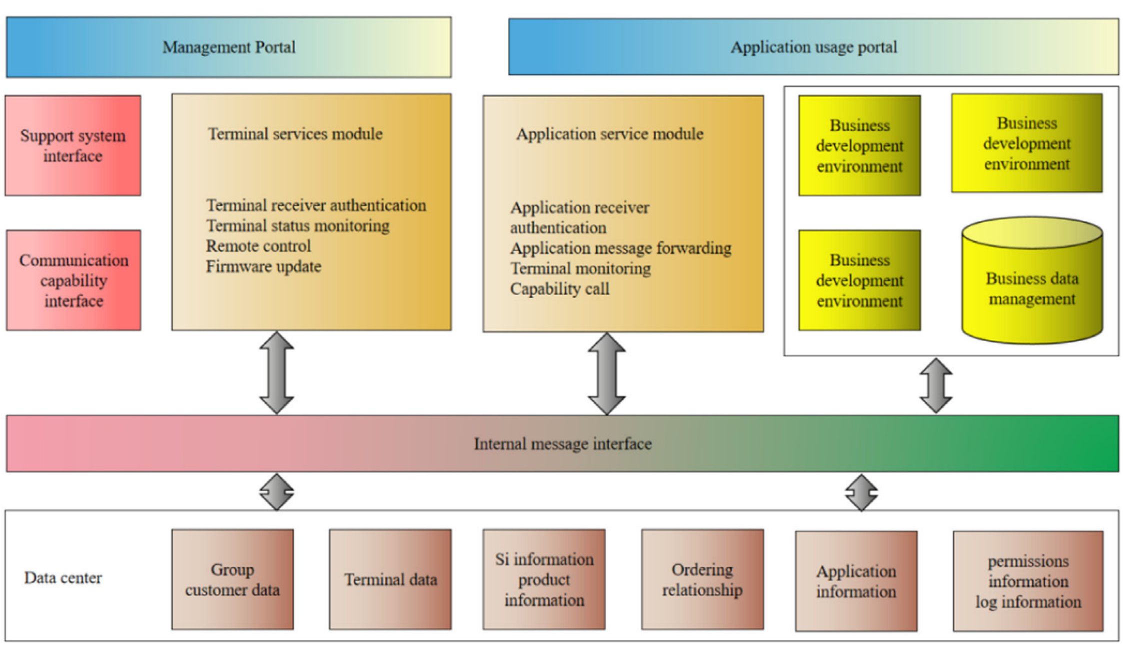

Fig. 1. Functional architecture of Internet of Things operation support platform.

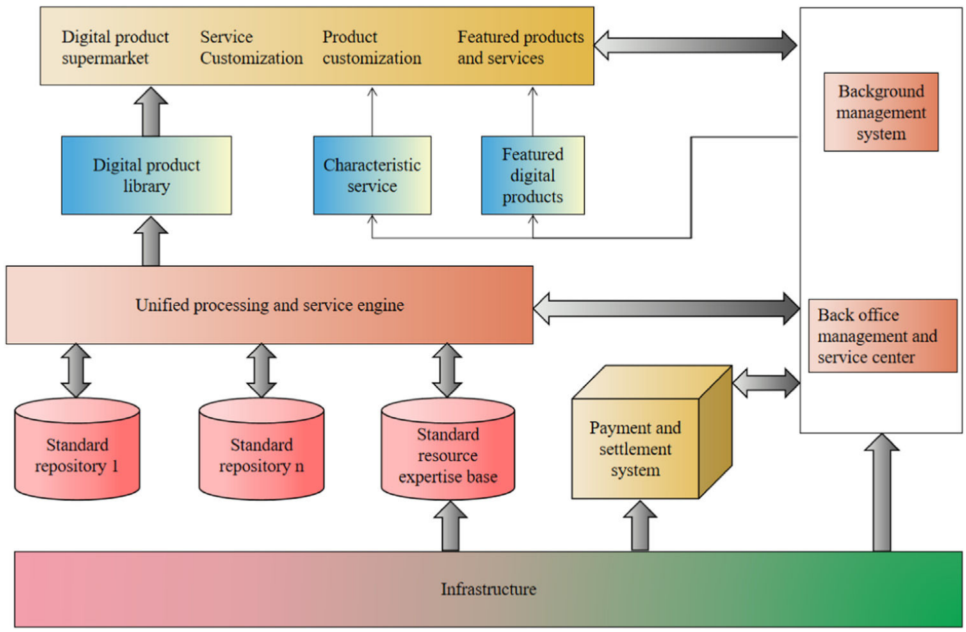

Fig. 2. Structure diagram of Internet of Things technology.

the agents, and the time series of the load information flow of the task scheduling system is as follows:

$$\{x(t_0 + i\Delta t)\}(i = 1, 1, ..., N - 1) \tag{1}$$

Discrete control is used for task scheduling, and the time series of real-time tasks is as follows:

$$\{x(t_0 + i\Delta t)\}(i = 0, 1, ..., N - 1) \tag{2}$$

In discrete control, the hop count at $1(n)$ layer is

$$hop\_count \tag{3}$$

In the clustering scheduling space for real-time task transmission, the communication data transmission channel between the $1(n)$ layer and sink is $\overline{D}_{l(m)}$, and the task flow to be allocated at this time is

$$x_k = \{x_1, x_2, ..., x_q\}, q \in N \tag{4}$$

Here, q represents the different characteristics of multiple task flows, xq represents the data sequence of the real-time task information flow in neighbouring nodes, and N represents the total number of tasks. Based on the collaborative distributed scheduling mode in the Internet of Things environment, the real-time unmanned transmission scheduling dataset is

$$X = \{x_1, x_2, ..., x_n\} \tag{5}$$

Here, n is the number of time slot allocation nodes X, and each element in X is a P-dimensional vector. Assuming that a frame is composed of M time slots, the attribute set of the i task scheduling class is

$$\upsilon_i = \{\upsilon_{i1}, \upsilon_{i2}, ..., \upsilon_{ip}\} \tag{6}$$

Thus, a real-time task scheduling model of the Internet of Things is obtained, and this model provides the basis and overall framework for the design of the task optimisation scheduling algorithm.

In the Internet of Things environment, the number of subnodes between equipment units is M. In process management, the required dual basis functions for time slot allocation at the ith moment must be satisfied.

$$\sum_{m=1}^{M} x_{mi} \geq N, i \in [1, N] \tag{7}$$

At this point, the ratio of the sum of the number of sin$k$ nodes in the real-time task transmission scheduling in the Internet of Things to the assigned time slot node υ_i has an autocorrelation:

$$\overline{D} = \frac{\sum_{l_i=1}^{M-1} \left| D_{l_i} \right|}{\sum_{j=1}^{M-1} \left| L_j \right|} \tag{8}$$

where D_{l_i} is the compactness measure of the clustering nodes and L_j is the autocorrelation measure. Through the above process, the real-time task scheduling in the Internet of Things environment is subdivided into K data subsets, and a real-time task clustering scheduling model with n fitness coefficients and excellent output control parameters is obtained as

$$\begin{cases} x = (x_1, x_2, ..., x_n) \\ y = F(x) = (f_1(x), f_2(x), ...f_m(x))^T \end{cases} \tag{9}$$

where $x = (x_1, x_2, ..., x_n)$ is the set of ontology model clustering units for real-time task scheduling and $y = F(x)$ represents a joint time scale function. Assuming that the type of real-time task attribute ni is rj, the discrete sampling set in the two-dimensional scheduling plane is

$$P(n_i) = \left\{ p_k \middle| pr_{kj} = 1, k = 1, 2, ..., m \right\} \tag{10}$$

Through the time frequency two-dimensional plane reorganisation, the priority attribute of task flow in the Internet of Things environment is rearranged, the real-time task scheduling information flow model is constructed, and the Internet of Things network management system architecture is constructed under a hybrid server.

The seamless coverage of task nodes and resource integration cluster centre containing the rule set for real-time task scheduling is

$$S = \left\{ s_i \middle| i = 1, 2, ..., N_s \right\} (S \subset C) \tag{11}$$

The Sin$k$ nodes in the Internet of Things are divided into rule and instance sets. Each node has a clock, and the multidimensional performance index between nodes is defined as

$$E = [E_G, E_T, E_T, E_W, E_L] \quad (12)$$

The scheduling state vector features $C \subset S$ and $F_{N\times 1}$ of each task transmission node are covered by a periodic grid according to the communication and scheduling periods between tasks. Based on the above analysis, the mathematical model of the structured information flow for real-time task scheduling is expressed as follows:

$$\begin{aligned} &\min F(x) = (f_1(x), f_2(x), \ldots, f_m(x))^T \\ &s.t. g_i \le 0, i = 1, 2, \ldots, q \\ &h_j = 0, j = 1, 2, .., p \end{aligned} \quad (13)$$

The two scalar feature sequences in the task transmission process are y_1 and y_2, and the balanced joint probability density function of the task transmission clustering scheduling is $f(y_1, y_2)$. In the concept of identification, the real-time task transmission data stream is divided into blocks as time slices to realise the information fusion of the task transmission information stream and improve resource integration in task scheduling.

Time slot allocation is used to manage the expansion and contraction of nodes, and time slot characteristics are extracted accordingly. For node i, N_i^1 is assumed to be the maximum hop number of the data transmission relay nodes such that the two-hop neighbouring nodes are obtained as follows:

$$N_i^2 = N_i^1 \cup \left(\bigcup_{j \in N_i^1} N_j^1 \right) \quad (14)$$

The maximum hop count of routing nodes is expressed by matrix X. According to the allocation mechanism of leading time slots, routing probe search is carried out to realise task scheduling. For the information transmission nodes of the Internet of Things with distance d and length $1bit$, the non-singular matrix of real-time task information transmission satisfies $P \in R^{n\times n}, R \in R^{m\times m}$, and $P \in R^{n\times n}, R \in R^{m\times m}$ whilst $H \in R^{m\times n}$satisfies

$$d_0 = \sqrt[n0]{\frac{\alpha_1 + \beta}{(n_0 - 1)\alpha_2}} \quad (15)$$

Through load balancing estimation, the balanced cross-term of task line nj executed by the Internet of Things process management processor pi decays as follows: nj

$$\begin{aligned} S_p(u) &= \{F^p[s(t)]\}(u) \\ &= \int_{-\infty}^{\infty} K_p(t,u)s(t)dt \end{aligned} \quad (16)$$

$s(t) \to s(t), s(t) \to S(f), s(t) \to s(-t), s(t) \to S(-f)$ is regarded as a zero-order, first-order, and second-order time−frequency balanced time scale transformation of task information flow. This transformation realises the time slot allocation scale feature extraction of task information flow. The extraction result is as follows:

$$g(t) = \sqrt{s}f(s[t - \tau]) \quad (17)$$

where $f(t)$ is the interrupt frame vector of the leading time slot; $s = (c - \upsilon)/(c + \upsilon)$ is the envelope scale of the time−frequency cross term, which represents the flexible change in the execution time of real-time task scheduling in the Internet of Things environment; and τ is the scheduling delay in the time period T.

The Internet of Things operation platform requires comprehensive insight and mastery of service modes, processes, and rules in different industries. However, the Internet of Things technology cannot be used as a universal system that is proficient and used in various industries. This realisation requires the cooperation and integration of third parties and other industries and the data and information provided by third parties to meet the applications and needs of different industries. Specifically, this collaboration can be achieved by building and operating an industry-level digital content operation platform in the professional field of standardisation, conducting digital content operations in the field of standard resources, constantly innovating the market service mode, improving the operational capacity of digital content resources, and providing society with products and services using standard digital content resources at home and abroad.

Third parties can provide multifunctional, user-friendly software and applications, and cloud platforms enable multiple customers to use virtual technology. As a global dynamic network, the Internet of Things can link anyone and anything, anytime and anywhere, through information sharing using specific equipment, sensors, and information processing technology. Fig. 3 shows the system framework of the Internet of Things according to its hierarchical structure specified by various telecom operators.

The Internet of Things business support platform is the key to the entire Internet of Things system. The platform can realise the unified

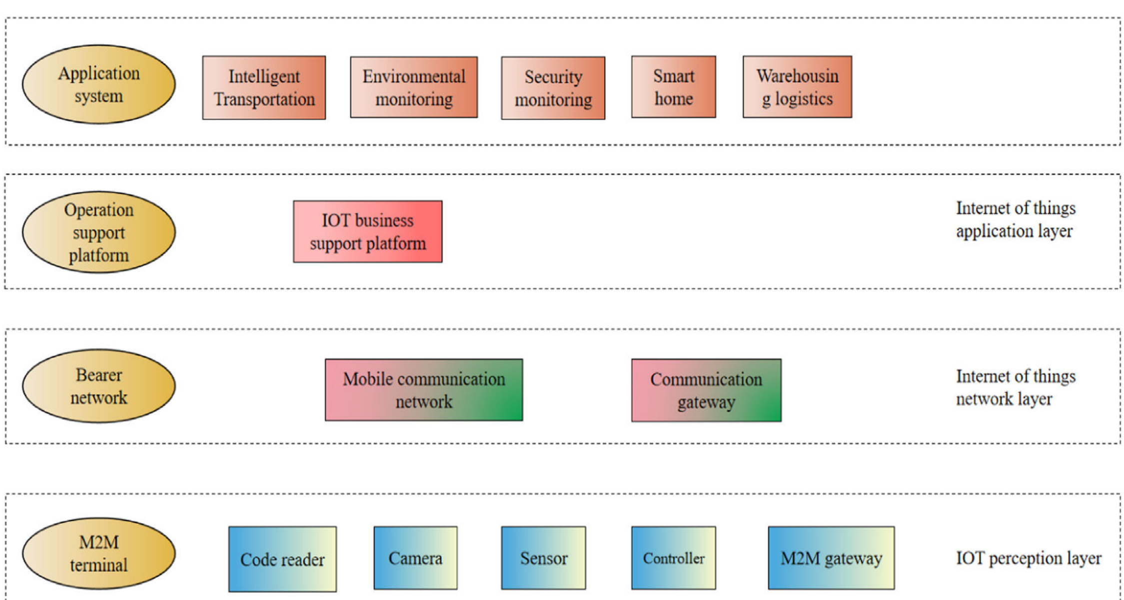

Fig. 3. Architecture diagram of the Internet of Things.

management of Internet of Things terminals, storage, and intelligent data analysis. It is the key for the communication between industry customers and professionals. The application of various technologies in Layer 3 has really achieved the final goal pursued by the Internet of Things, that is, ‘more thorough perception’, ‘more comprehensive interconnection’, and ‘deeper intelligence’.

Construction of enterprise digital service and operation platform

Construction of enterprise digital service and operation platform based on Internet of Things technology

The operation platform of the Internet of Things also needs to have the following functions. As a supplier in the Internet of Things service industry, it must have a set of specific operation service modes for customers, network sensor businesses, and third-party application providers. In addition, relevant standards and specifications must be formulated for the production and service of standard resource digital products, a cloud processing and production centre must be built for standard resource digital products and services, and the standard resources of all resource parties on the platform must be processed and produced through a unified product and service production engine to create a digital product promotion platform for standard resources. These functions should be provided on the operation platform. The media portal and service operation platform for various providers of standard resource digital content involves many technologies to support and realise specific functional modules. In the operation and service of standard digital resources and products, website content management, template engines, multiple publishing, copyright protection, user behaviour mining and analysis, intelligent association, intelligent recommendations, and other technologies provide technical support for the construction of a strong product and service operation platform. The amount of data sent at one time in the main function is changed to test the data processing performance, as shown in Table 1.

According to the data in Table 1, under the same conditions, the peak value of the data processing efficiency of a single thread in the asynchronous architecture is approximately 4400 pieces/s, whereas that in the synchronous architecture is approximately 1300 pieces/s. The processing performance of the asynchronous architecture is improved by 330% relative to that of the synchronous architecture. A total of 1000 data points are created for device 1, and the storage attributes of all the data points are true. The duration between receiving and storing the test data is tested, and the unit time is calculated. Table 2

Virtual technology can be used to attract multiple customers, allowing each tenant to share resources. Telecom merchants charge rental fees based on customer needs or purposes, thereby increasing the efficiency of resource sharing, reducing unnecessary costs for operators, and creating a virtuous ecosystem that integrates remote users, third parties, and operators. According to the current server performance requirements, the number of consumer threads in the producer–consumer model is set to 20; that is, 20 threads are started simultaneously for message processing. Then, the duration between message generation and storage is tested, the data processing efficiency is calculated, and the processing efficiencies of single and multiple threads sending the same message content are compared, as shown in Table 3.

If you want to build, you need to be ready to set up and assemble the infrastructure. Network sensing, physical information resources, and virtual storage pools constitute the prototypes of cloud foundation. In general, a virtual storage pool can only be used with the support of relevant storage devices that maximise its function.

Table 1
Test results of data concurrency.

Total messages (pieces)	Asynchronous processing performance (strips /s)	Synchronous processing performance (strips /s)
110	879	152
520	1526	388
1100	1958	532
5200	3008	1222
11,000	2922	1125
14,000	3453	1102

Table 2
Test results of different data lengths.

Number of data points	Processing time (MS)	Processing efficiency (PCs. / s)
1	6271	4151
120	57,285	43,917
520	217,900	57,574
1200	400,144	62,693

Table 3
Comparison of processing performance for different threads.

Total number of messages (pieces)	Single thread processing performance (bar/s)	Multi-thread processing performance (bar/s)
120	898	985
520	1386	1569
1200	1885	2484
5200	2869	4625
12,000	2887	5314

Experimental results and analysis

The proposed method in this study, data mining algorithm, decision tree algorithm, and deep learning algorithm are used to compare the balance between enterprise digital service and operation platform construction under the Internet of Things environment. Three experiments are performed to compare the results, and they are demonstrated in Figs. 4, 5, and 6.

Figs. 4–6 show that in the three experiments, the algorithm in this study, data mining algorithm, decision tree algorithm, and deep learning algorithm are used for task transmission clustering scheduling, and they show a higher degree of balance than traditional methods. As the signal-to-noise ratio increases, through efficient time-division multi-access slot allocation, the balance degree of task scheduling reaches 100%, effectively improving the balance and accuracy of real-time task transmission clustering scheduling and reducing the storage overhead. Digitalisation has created new opportunities for manufacturing enterprises and has become a

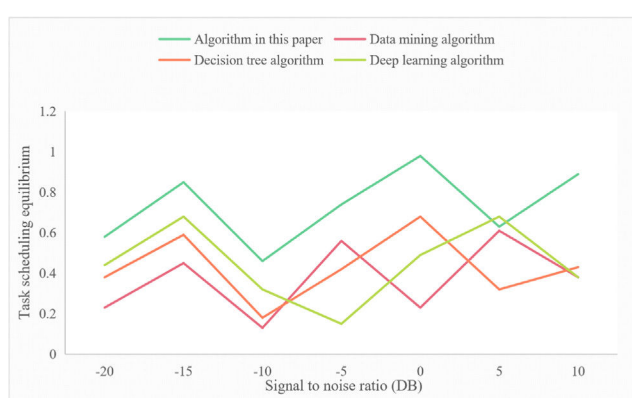

Fig. 4. Initial performance comparison.

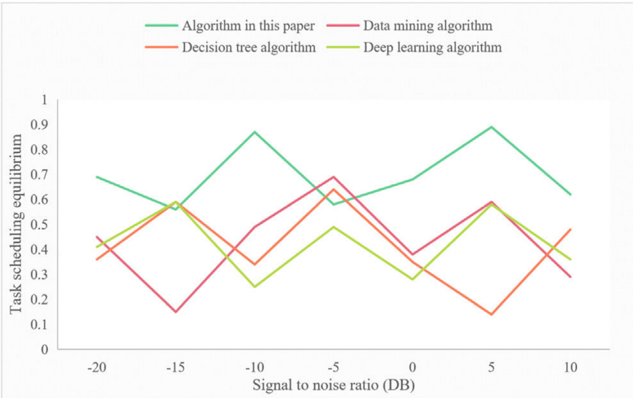

Fig. 5. Second performance comparison.

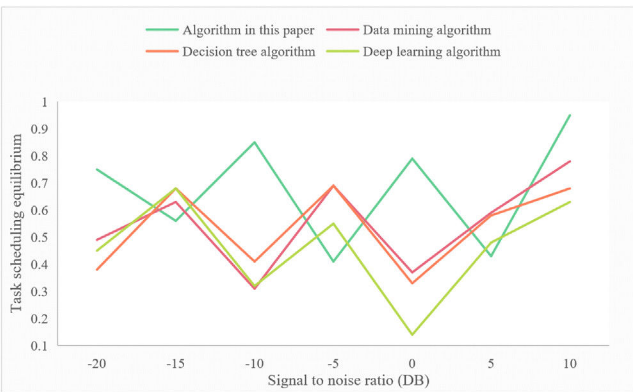

Fig. 6. Third performance comparison.

driving force for their service-orientated transformation and upgrading in the new era. Manufacturing companies are beginning to use digital systems to provide services to customers.

Although manufacturing enterprises can promote service-orientated development without digitalisation, they can also develop digitalisation without promoting service-orientated development. How do we utilise emerging digital technologies for service innovation to form new competitive advantages? Many manufacturing enterprises lack not only operational experience and knowledge but also strategic understanding. Blind investment, construction, and imitation increase costs and hinder the achievement of expected goals. However, a strong interaction exists between service-orientated and digital technologies, and their trends are converging.

Using the proposed algorithm, a real-time task scheduling model of the Internet of Things is constructed, and the real-time task information flow of the Internet of Things with different information sampling channels and signal-to-noise ratios is obtained, as shown in Figs. 7, 8, and 9.

The task information flow of the Internet of Things shown in Figs. 7–9 is a signal model. The task information flow includes nonlinear signals with three frequency components: 18, 15, and 20 Hz. The fundamental frequency of the time spectrum is 100 Hz. Based on the above task information sampling, feature extraction is performed to extract the time slot allocation scale characteristics of the task information flow, achieve feature decomposition and balanced design for the three-channel Internet of Things task information flow, and obtain the time slot allocation scale feature decomposition spectrum. The use of the proposed method to perform efficient time slot allocation scale feature decomposition for real-time transmission tasks reveals its good beam directivity and feature focusing ability. The method can also clearly obtain the frequency composition of the

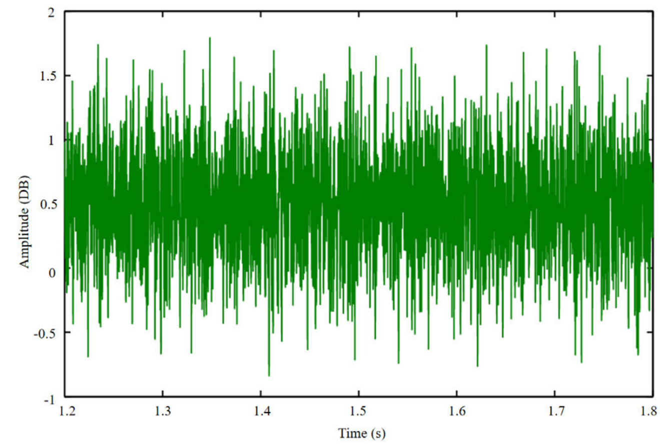

Fig. 7. Time domain sampling of the first real-time task information flow in different channels in the Internet of Things environment.

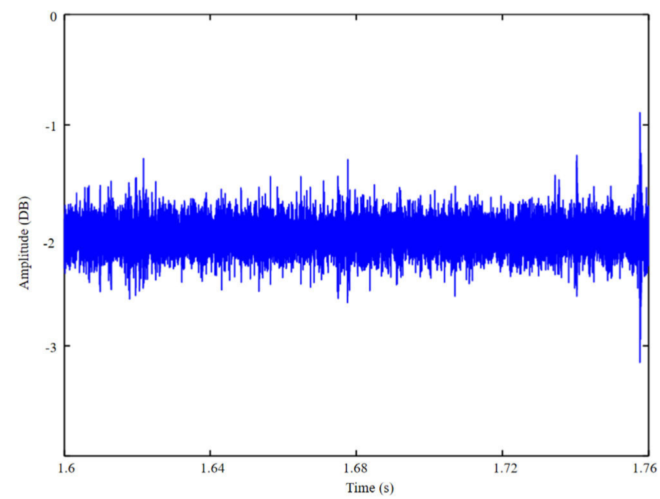

Fig. 8. Time domain sampling of the second real-time task information flow in different channels under the Internet of Things environment.

original task information flow and the dynamic characteristics of frequency changes over time. Using this as a directional feature, a task allocation balancing index is developed to improve the balancing allocation ability of task scheduling. A technical system can be divided from the perspective of the technical field to achieve

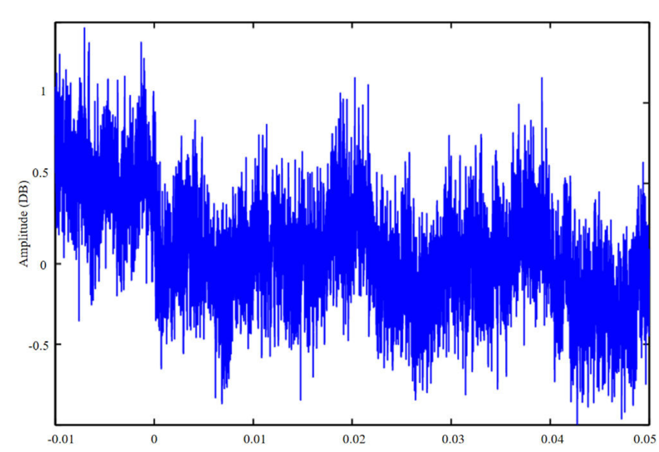

Fig. 9. Time domain sampling of the third real-time task information flow in different channels under the Internet of Things environment.

professional domain governance. Six technical systems (users, terminals, networks, systems, applications, and data) cover the key security areas. The key to unique technical considerations in the user domain lies in a unified identity management mechanism and single sign-on identity authentication technology.

Establishing and operating an industry-level digital content operation platform in the field of standardisation, carrying out digital content operations with standard resources, continuously innovating market service models, improving the operational capacity for digital content resources, and providing society with digital products and services at home and abroad. At the terminal level, attention should be paid to asset management centred on security attributes, including elements such as identity, attributes, and vulnerabilities. Attention should also be given to terminal access management, including integrity, compliance construction, and terminal identity authentication. Focus should likewise be directed towards the intrusion and destruction of malicious software in terminals. Based on the above task information sampling, feature extraction is performed to extract the time slot allocation scale features of the task information flow and achieve feature decomposition and a balanced design for the three-channel Internet of Things task information flow.

Conclusion

With the continuous development and progress of science and technology, cloud management, cloud applications, and other modes will constantly be updated and expanded. The construction of enterprise digital service and operation platforms is based on national standard resources. It combines the standard resources of other publishing houses horizontally and the related resources in the field of market supervision vertically. This combination leads to the construction of a collaborative service system. To complete the construction of cloud computing and the Internet of Things operation platform, a network platform must be built. This platform must have three centres: an information centre, information processing centre, and information analysis centre. The operation platform architecture, with distributed independent sub-functional modules, facilitates the more targeted construction of the sub-functional system of the operation platform for powerful enterprise digital service and information management based on the Internet of Things technology. The simulation experiments reveal that the proposed algorithm, data mining algorithm, decision tree algorithm, and deep learning algorithm are more balanced than traditional methods for task transmission clustering scheduling. As the signal-to-noise ratio increases, through efficient time-division multi-access slot allocation, the balance degree of task scheduling reaches 100%, thus effectively improving the balance and accuracy of real-time task transmission clustering scheduling, reducing storage overhead, and improving the fidelity rate of task scheduling information transmission. The public cloud service platform combines other standard resources and products to develop a unified digital product processing and service engine, forms a standard digital product library of resource content, and provides personal and institutional users with standard digital products and personalised services.

Data availability statement

The data used to support the findings of this study are included within the article.

Declaration of Competing Interest

The authors declare that they have no competing interest.

CRediT authorship contribution statement

Qianying Gao: Conceptualization, Methodology, Writing – original draft. **Qi Wang:** Validation, Formal analysis, Writing – review & editing. **Cisheng Wu:** Conceptualization, Methodology, Supervision.

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