ISSN: 2472-3703 DOI: 10.6911/WSRJ.202101_7(1).0024

Summary for Optimization Strategy of the Organizational Structure in IoT

Mengmeng Du[1, a, *]

[1]School of Computer Science & Technology, Tiangong University, Tianjin, 300387, China

[a]17097491@qq.com

Abstract

Currently, with a large number of smart devices, such as smartphones, smart sensors, etc., becoming the main components of the Internet of Things (IoT) system, the architecture of IoT system has the characteristics of enormous diversity. Moreover, without some external technologies, the performance of IoT system mainly depends on the organizational structure of the system itself. Therefore, the organizational structure of the IoT system plays a decisive role in the IoT performance. In this article, we briefly describe how the structure of the IoT system affects the performance, and summary the methods and strategies for optimizing the organizational structure of IoT in the past.

Keywords

Internet of things; Smart device; Organizational structure; Optimizing strategy.

1. INTRODUCTION

At present, the Internet of Things (IoT) technology has been widely used in life and work. In recent years, IoT technology has been widely used in urban traffic management [1], engineering construction safety management, hazardous chemical safety management [2], mine safety inspection [3], tourism safety management [4], fire safety management [5], natural disaster prevention, flood prevention and drought relief, agriculture, etc. Areas.

In the field of urban traffic management [1], the IoT technology used a series of intelligent equipment to monitor and control relevant scenes in real-time in urban road traffic safety, water traffic safety, and urban rail traffic safety scenarios. In the field of fire safety management, a series of solutions are designed based on the related technologies of the Internet of Things, which will build a perception system and a fire safety control platform for key fire facilities in the city, and manage and monitor related equipment. In terms of natural disaster prevention [7], the advanced IoT technology is used to briefly describe major natural disaster prevention facilities, such as flood prevention dams, and establish a safety monitoring and protection perception platform, focusing on monitoring rivers and reservoirs, especially small and medium rivers, and small reservoirs, and implement monitoring, forecasting, and early warning. In terms of urban operation safety, we can build an urban operation monitoring system based on the Internet of Things system and advanced communication technology, which can detect and monitor changes in urban energy, civil air defense, environmental protection, and pipeline networks. In terms of rail transportation, the current more advanced artificial intelligence technology, big data analysis technology, Internet of Things and other new technologies are used to build smart stations. Among them, the Internet of Things is one of the important basic technologies of smart stations, which can be applied to energy consumption management and monitoring of station internal equipment, face recognition of inbound passengers, and environmental comfort monitoring of station waiting halls.

ISSN: 2472-3703 DOI: 10.6911/WSRJ.202101_7(1).0024

In addition, with the popularization of a series of smart devices such as smartphones and smart sensors, smart devices have gradually become the main components of the IoT system. It plays a decisive role in the further development of the Internet of Things that how to increase the performance of the external system of the Internet of Things. Since the smart device itself has certain data processing capabilities, decision-making capabilities, communication capabilities, and computing capabilities, it can improve the overall performance of the IoT system to a certain extent. At the same time, due to the development and application of 5G technology, the data transmission rate between the components of the Internet of Things has been increased, the delay has been reduced, and the overall performance of the Internet of Things system has also been improved to a certain extent [7]. In addition, some information processing tasks in the Internet of Things system are gradually pushed to the edge of the network for processing in order to improve the overall performance of the Internet of Things [8] [9]. In the field of the Internet of Things, when the Internet of Things system is composed of the same number and types of devices, the self-organization forms between the devices are different, so that the organizational structure of the system is different, and its performance is also uneven. Therefore, the appropriate system architecture is the main factor determining system performance.

The remaining chapters of this article are arranged as follows. In Section 2, we respectively summarized the literature on the optimization strategy of the organizational structure of the IoT system according to the method categories of the organization optimization. In Section 3, based on previous optimization strategies, we gave some conclusions and future research directions.

2. RELATED WORKS

In the field of IoT, when the IoT system is composed of the same number and type of devices, the organization way of the devices for IoT is different, so that the organizational structure of the IoT system is different, and its performance is also uneven. Therefore, a suitable and excellent system architecture form is the main factor affecting system performance. The core of the organizational structure of the IoT is to reasonably combine these devices from a certain number of devices to form an efficient IoT system so that the collective effect of the mutual cooperation between the devices in the system is maximized, so as to deal with the problems faced by the Internet of Things system at any time. Therefore, in essence, the optimization of the organizational structure of the Internet of Things is an Np-hard problem.

Gaia [10] and MONI [11] designed a system organization structure design method, and proposed a guideline to guide designers how to manually design the Internet of Things system. However, to manually design the organization way of the equipment in the system, the design process takes a lot of time and cost, and the performance of the designed system is largely dependent on the designer's own knowledge reserve and design experience, and the performance is difficult to guarantee. When designing a large-scale system, it is more difficult to ensure the overall performance of the system manually and the time cost is difficult to estimate.

In the literature [12], the author proposed the Organization Design Modeling Language (ODML). Take the common IoT application system as an example, under the environment of the distributed sensor system and information retrieval system. The author defines a quantitative organizational fitness function to measure overall system performance. Although this method uses hard constraints, equivalence classes, parallel search and abstract thinking to design the system structure, it helps designers reduce the complexity of system organization design. However, the nature of the method has not changed, and this design process still largely depends on the designer's own knowledge.

ISSN: 2472-3703 DOI: 10.6911/WSRJ.202101_7(1).0024

In addition, KB-ORG [13], an organizational structure researcher for agent system, used organizational structure knowledge of application levels and collaboration levels to selectively discover useful part of the system organization. Similar to the ODML method, the KB-ORG method only helps designers delete part of the useless system organization, but in the system organization structure design process, manual methods still dominate.

In the literature [14], the author proposed a method, the hierarchical search algorithm based on genetic algorithm (HAS-GA), to optimize the organizational structure of the system. Based on the classic genetic algorithm, he proposed a mapping method for gene representation. This method expresses the complex IoT system organizational structure scheme in the form of integer coding, according to the overall performance fitness function of the system. By setting the total number of devices, and adopting a special hierarchical crossover method [14] and a small disturbance mutation method [14], this method can automatically search for suitable IoT system organization examples. The algorithm proposed by the author replaces the previous exhaustive method, replaces the manual design method to a certain extent, and greatly reduces the time cost.

3. CONCLUSION

The organizational form of the IoT devices greatly affects the performance of the Internet of Things, and the organization and optimization of the system structure is also a classic Np-hard problem [14]. In this paper, we detail the importance of the organizational structure of the IoT system, summary the past organizational structure optimization methods, and gave the advantages and disadvantages of their methods.

Therefore, in real life, a good organizational structure optimization strategy for the IoT system can help designers with inexperienced development to design an IoT application system that meets certain requirements. Its potential application areas include scene trees and decision trees optimization. In future research, we will further explore these directions.

REFERENCES

[1] Ronghua Zhang, Haibo Wang.Intelligent Transportation System Design based on Internet of Things [J]. Electronic World,2020(19):138-139.

[2] Wan Hong. Application of Internet of Things Technology in public Security Management of Explosive - prone Hazardous Chemicals [J]. China Public Safety,2020(05):155-158.

[3] Geng Xiaojun. What can the Internet of Things do in the face of disaster[J]. Internet of things technology,2017,7(08):3+5.

[4] Tan Deze, Li Lixin. Application of 5G in Internet of Things and Tourism Security Information Acquisition Technology [J].Network Security Technology and Application,2019(08):96-97.

[5] Che Hui, Xing Huifen, Fan Yuqi, Zheng Shu-li.Intelligent fire early warning system based on big data [J]. Computer system application,2020,29(10):120-126.

[6] Geng Xiaojun. What can the Internet of Things do in the face of disaster[J]. Internet of things technology,2017,7(08):3+5.

[7] Kiani A, Ansari N. Edge Computing Aware NOMA for 5G Networks[J]. IEEE Internet of Things Journal, 2018, 5(2): 1299-1306.

[8] Shen Z , Yu H , Yu L , et al. Dynamic Generation of Internet of Things Organizational Structures through Evolutionary Computing[J]. IEEE Internet of Things Journal, 2018, PP(99):1-1.

[9] Boxma O , Walraevens J . Computational methods and applications in queueing theory[J]. Annals of Operations Research, 2017, 252(1):1-2.

ISSN: 2472-3703 DOI: 10.6911/WSRJ.202101_7(1).0024

[10] Wooldridge M , Jennings N R , Kinny D . The Gaia Methodology For Agent-Oriented Analysis And Design[J]. Autonomous Agents and Multi-Agent Systems, 2000, 3(3):285-312.

[11] Javier Vázquez-Salceda, Dignum V , Dignum F . Organizing Multiagent Systems[J]. Autonomous Agents and Multi-Agent Systems, 2005, 11(3):307-360.

[12] Horling B , Lesser V . Using quantitative models to search for appropriate organizational designs[J]. Autonomous Agents and Multi-Agent Systems, 2008, 16(2):95-149.

[13] Sims M , Corkill D , Lesser V . Automated organization design for multi-agent systems[J]. Autonomous Agents and Multi-Agent Systems, 2008, 16(2):151-185.

[14] [Shen Z , Yu H , Yu L , et al. Dynamic Generation of Internet of Things Organizational Structures through Evolutionary Computing[J]. IEEE Internet of Things Journal, 2018, PP(99):1-1.