

Ministry of Education of the Republic of Belarus
Educational institution
Belarusian State University of
Informatics and Radioelectronics

UDC 339.138

YU
Chu Yue

**ORGANIZATION OF SMART HOME MANAGEMENT USING THE
INTERNET OF THINGS NETWORK**

Abstract
for a Master's Degree
in the Specialty 1-45 80 01 Infocommunication Systems and Networks

Supervisor
Doc. Of Sc., Professor
Vishniakou Uladzimir Anatolievich

Minsk 2022

INTRODUCTION

In 1984, United Technologies Corporation of the United States established the first "smart building" in Hartford, Connecticut, USA, which opened the prelude to the smart home. The emergence of the Internet of Things (IoT) has set off a boom for smart homes. The IoT connects objects to objects, objects to people, and people to people through RFID, sensor technology and embedded technology, making the smart home no longer out of reach. From the initial research and development to the current status of mass marketization, IoT smart home has transformed from a concept into a product.

IoT smart home system is a research hotspot at present. IoT replaces complex wiring technology with wireless communication technology. Inexpensive sensors have also greatly reduced the cost of smart homes. The aim of the dissertation is to enable the development and modeling of IoT networks that manage smart home components in IoT cloud platform.

This master thesis (MT) proposes IoT network simulation of SH with the mobile phone and the IoT cloud platform. In MT introduces the concept and development of IoT smart home . The layers describe the architecture of the IoT smart home. The work of this thesis is mainly to realize the simulation of smart home system on the cloud platform. After the demand analysis of the smart home system, this paper selects and describes the selected cloud platform in detail, and takes the street lamp as an example, creates an example and simulates the entire operation process of the system, and describes the implementation technology of the system. Finally, the future development of the IoT smart home system is summarized and prospected.

The first chapter briefly describes the concept and development of IoT smart home, and describes the model and architecture of IoT in detail, including perception layer, network layer and application layer, and analyzes and compares the transmission methods of IoT.

Chapter 2 details the model and structure of IoT networks for smart home management. The IoT network model for home component management, the structure of the model and the algorithm implementation, including the sensor network model, are introduced. Based on the windows platform, it briefly describes how to realize the smart home simulation of the cloud platform.

The third chapter analyzes the requirements of the IoT smart home, analyzes and selects the cloud platform of the system in this thesis, and actually builds and realizes the simulation of the IoT network smart home on the base of mobile phone and Alibaba cloud platform. In conclusion is summarized the main results of research work.

GENERAL DESCRIPTION OF WORK

Connection of work with major scientific programs

The topic of the dissertation work corresponds to paragraph 1 of the priority areas of scientific, scientific, technical and innovative activities of the Republic of Belarus for 2021–2025, approved by Decree of the President of the Republic of Belarus No. 156 of May 7, 2020 “Digital information and communication and interdisciplinary technologies based on them "Belarusian State University of Informatics and Radioelectronics". Dissertation research was carried out within research work SB 21-2033 «Processing, coding and transmission information in network-centric systems».

Purpose and objectives of the study

The aim of the dissertation is to develop and modeling of IoT network that manage smart home components in a cloud platform.

To achieve this goal, the following tasks were solved in the dissertation:

1 Introduce the basic knowledge of the concept, architecture and development of a Internet of Things.

2 A detailed proposing of the IoT system for smart home, including models, structures, algorithms.

3 Simulating the IoT system for smart home on cloud platform with use a smartphone to modeling sensor and visualization.

Personal contribution of the degree applicant

The content of the dissertation reflects the personal contribution of the author. It consists in the scientific substantiation of algorithms, methods, software, setting up and conducting experiments to study characteristics, evaluate the effectiveness of the developed IoT system smart home, process and analyze the results, formulate conclusions.

Task setting and discussion of the results were carried out together with the Supervisor Doc. of Sc., Professor Vishniakou Uladzimir Anatolievich.

Approbation of the dissertation and information on the use of its results

The main provisions and results of the dissertation work were reported and discussed at international conference: Telecommunications: Networks and technologies, algebraic coding and data security (Minsk, November - December 2021).

Publication of the results of the dissertation

According to the results of the research presented in the dissertation, 4 author's works were published, including: 3 articles in international conference proceedings. One article was sent to journal « Reports of BSUIR ».

The structure and scope of the dissertation

The dissertation work consists of an introduction, a general description of the work, three chapters with conclusions for each chapter, a conclusion, a bibliographic list.

The total volume of the dissertation work is 96 pages, of which 72 pages of text, 57 drawings on 33 pages, 2 tables on 2 pages, a list of bibliographic sources used (51 titles on 4 pages), a list of the author's publications on the dissertation topic (4 title on 2 pages), graphics on 12 pages.

Check for uniqueness

The examination of the dissertation Full name " Organization of smart home management using the internet of things network " was carried out on the correctness of the use of borrowed materials using the network resource "Antiplagiat" (access address: <https://antiplagiat.ru>) in on-line mode on 30/03. As a result of the check, the correctness was established the use of borrowed materials (the originality of the dissertation is 93.27%).

SUMMARY OF WORK

The **introduction** addresses the problems of development and modeling of IoT networks for managing smart home components.

The **general description of work** shows the connection between the work and the priority areas of scientific research, the aim and tasks of the research, the personal contribution of the applicant for a scientific degree, the approbation of the dissertation results.

In the first chapter described the IoT network for smart home management in detail. In Sections 1.1 and 1.2 we introduced the connection and concept of smart home and IoT. Section 1.3 described the IoT network architecture for managing furniture components. Section 1.4 provided an in-depth look at local communication methods for IoT, and section 1.5 described how IoT can be used in home management with examples.

In the second chapter the focus is on the IoT network model and structure of smart home management. In section 2.1 the centralized IoT network model is introduced, including WSN network model, MANNA sensor management system. The management of IoT components is described in detail in section 2.2. The

Internet of Things network structure was discussed common home network management technologies. Section 2.3 related to the algorithm of the Internet of Things network management home components. Section 2.4 described the smart home network cloud platform with examples.

In the third chapter first determined the framework of the smart home platform according to the design requirements, introduced each functional section in the framework, and discussed the selection scheme of related devices, including human body sensors, temperature and humidity, light control and other sections [2-A, 3-A]. It also introduced the key technologies in the system, including the comparison of various wireless communication protocols, analyzed their advantages and disadvantages, and finally selected the MQTT protocol; then introduced the Alibaba Cloud platform, Tencent platform and China Mobile Internet of Things cloud platform, combined with system design requirements. The Alibaba Cloud platform was selected as the cloud server for this design to simulate the sensor connection and message transmission of the Internet of Things.

Then the software design of the whole system was simulated, and the running process of the whole system was shown by taking the creation of street lamp as an example. The overall design of this system was based on the Alibaba Cloud platform, which realizes two-way communication between the device control terminal and the user terminal; the main controller controlled various sensors to collect various data. Sensors, smoke sensors, and natural gas sensors can monitor whether someone enters or exits illegally at any time, and whether the gas concentration in the environment exceeds the standard, etc., and realized abnormal information reminders through buzzer alarms; and then uploaded the data to the Alibaba Cloud platform through the MQTT protocol, and users can use mobile phones. The APP checks the changes of the home environment in real time, and issues commands to the relay and other executive terminals to control the home equipment at any time according to the data changes [4-A].

CONCLUSION

1 The design of this thesis is based on the knowledge learned in social practice, through consulting and analyzing relevant domestic and foreign literature materials, a series of work carried out for the research content. During the whole process, author has conducted in-depth study on embedded development technology, MQTT protocol, IoT cloud platform, wireless communication and other technologies, and accumulated experience for future related work [1-A].

Combined with user needs and enterprise development requirements, this design uses the Alibaba Cloud platform to achieve fast and reliable data transmission through various sensors, buzzers, relays, RGB lights and other executive devices,

using MQTT as the access protocol. As far as some current smart home systems are concerned, this system is more compatible and suitable for more occasions. The work completed in this paper mainly includes:

2 Starting from the research background and significance, combined with the current development status of the system at home and abroad, author consulted a large number of documents and found that people are now pursuing a safe, healthy and comfortable living environment, and major manufacturers are also trying their best to make technological breakthroughs. Working out a smart home solution that meets the needs of users and find that this is a direction worthy of research. Then according to various needs and various technologies, the devices used are reasonably selected, and the smart home solution of "using cloud platform technology to simulate the realization of smart home" is proposed. And in-depth study of the key technologies applied in the system.

3 The structures of some IoT system are designed and the system is tested many times. First, the online problems of the system are tested, and the system is finally run normally after program modification and debugging. Then take the street lamp as an example to create an instance on the cloud platform, so that the relevant information of the street lamp can be transmitted to the cloud platform and realize duplex interaction, so as to realize the mobile phone control device [2-A, 3-A].

4 The system is designed with four main features [4-A].

- Promote the development of single product intelligence to intelligent linkage, and integrate monitoring sensors into the same device for all smart home products to meet the multi-functional needs of users. Users can realize remote intelligent monitoring through the mobile APP. The monitoring of temperature and humidity, light intensity, sound and other parameters that mainly affect user comfort and human health creates the most healthy and comfortable living environment for users; the monitoring of indoor smoke concentration is very good for whether strangers enter illegally and user's personal and property safety.

- Using the mature and powerful Alibaba Cloud platform reduces the difficulty of development, shortened the development process, and reduces costs.

- Use the MQTT protocol to complete data transmission from hardware to the Internet: open source, reliable, lightweight, simple and other characteristics make the data transmission cost small and stable. At the same time, MQTT is widely used and can cooperate with more enterprise products, which enhances the practicability of the system.

Although the system designed this time has completed most of the functions, due to its limited level and lack of experience, there are some problems that can be solved in the future.

For the development of this function, there is still a lot of room of improvement for the current ability of individuals. In the future, different sensors can be added according to different needs to make the device function more diverse.

System prospects: In addition to being used as a smart home, the system designed this time can also be used in various scenarios such as fire prevention and control, greenhouses, cultural relics protection and prevention through adjustment in the future. At the same time, the MQTT protocol is widely used and can cooperate with more enterprise products for better development and application in the future.

LIST OF AUTHOR'S PUBLICATIONS

1-A Vishniakou U.A. IoT network: models, structure, communications, problems / U.A. Vishniakou, Du Zongqi, Liu Zhenhua, Hu zhifeng, Yu Chunyu // Телекоммуникации: сети и технологии, алгебраическое кодирование и безопасность данных: материалы Международного научно-технического семинара (Минск, ноябрь – декабрь 2021 г.) Telecommunications: Networks and Technologies, Algebraic Coding and Data Security. – Минск: БГУИР, 2021. – pp. 57 – 61.

2-A Yu Chuyue. Design of school bell automatic control system based on single-chip microcomputer / Yu Chuyue, Xia Yiwei, Du Zongqi, Liu Zhenghua // Телекоммуникации: сети и технологии, алгебраическое кодирование и безопасность данных : материалы Международного научно-технического семинара (Минск, ноябрь – декабрь 2021 г.) Telecommunications: Networks and Technologies, Algebraic Coding and Data Security – Минск : БГУИР, 2021. – pp. 69-71.

3-A Yu Chuyue. Design Of Smart Code Lock / Yu Chuyue, Xia Yiwei, Zhao di, Hu Zhifeng // Телекоммуникации: сети и технологии, алгебраическое кодирование и безопасность данных : материалы Международного научно-технического семинара (Минск, ноябрь – декабрь 2021 г.) Telecommunications: Networks and Technologies, Algebraic Coding and Data Security – Минск : БГУИР, 2021. – pp. 72-74.

4-A Vishniakou U.A. Development and modeling of the internet of things network for managing smart home components in platform / U.A. Vishniakou, Yu Chuyue // Doklady BSUIR, 2022. (In published).