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Research paper

Design of Remote Power Management and Control Solution in IoT Device Environment

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Abstract

Background/Objectives: The existing remote power management and control solution is controlled from the outside through the internal router. That is, if there is an internal firewall, the access path is limited due to complicated network setting. In other words, there is a problem that connection can be limited because the hub server and the public IP address are required to access from the outside.
Methods/Statistical analysis: There is a need for a way to build a remote control and power management system on the remote device itself. Thereby, the user does not need any additional setting for power management or control to the remote device. That is, there is a need for a remote power management and control solution capable of freely controlling power and control remotely in the Internet environment even if a firewall exists inside.
Findings: In this paper, we manage and control the power of the target terminal remotely from the client terminal to the target terminal via the main server and the hub server. In addition, in the internal firewall environment, a remote terminal requests power to the target terminal via the server. Finally, the remote connection of the target terminal can be wired/wireless in the hub server, and the corresponding function is installed by installing separate hardware in the target terminal.
Improvements/Applications: In this paper, we design a solution to remotely manage and control power in IoT device environment. This enables the development of a system that can reduce the energy efficiency of remote devices and eliminate standby power. It is a technology that provides a fundamental solution for remote power management in IoT environment by allowing users to turn on / off the computer or device at any time and remotely manage it.

Keywords: *Remote power management, Power control, IoT Environment, Out bound method, WOL function*.

1. Introduction

IoT Service In the technical environment, the most important thing is to provide stable power supply while the system is operating without failure. Of course, unwanted failures often arise because networks have diverse and complex variables. Therefore, a remote power management and control solution is desperately needed in order to fundamentally prevent obstacles in the power-related part[1,2]. Remote power management and control solutions are based on high-capacity power distribution, minimizing power-related failures due to human error. In addition, it is a system that can monitor, manage and control the power of remote equipment conveniently on the network[3].Of course, remote power management and control solutions have been developed and commercialized. However, the existing solution is to control from the outside through the internal router[4,5]. Therefore, if there is an internal firewall, a complicated network configuration must be performed, so that the access path is limited. That is, in the existing method, the WOL function must exist in the device for remote control and power management. Also, there is a problem that connection is limited because it can be accessed from the outside only by having a hub server and a public IP address.

As a result, there is a need to build a remote control and power management system on the remote device itself. That is, there is a need for a remote power management and control solution capable of freely controlling power and control remotely in the Internet environment even when a user does not need any separate setting for power management or control to a remote device and a firewall exists inside.

Therefore, in this paper, the remote control power management system is designed not to have a public IP address. Also, it is possible to control the power management and access control for the target terminal device in a remote network without setting up a separate network or computer even in the presence of an internal firewall.In other words, we have designed a system that can remotely manage and control the power supply to reduce the energy efficiency of the remote device and to eliminate standby power. This enables a user to turn on / off the computer or IoT device at any time and remotely manage it, thereby providing a fundamental solution for remote power management.

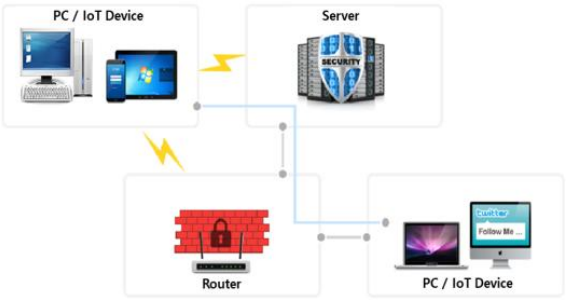

Figure 1: Remote power management & control solution overview

2. Related Work

2.1. IoT Trends

The Internet of Things (IoT) refers to the ecosystem of connected physical objects accessible via the Internet. In particular, the IoT ecosystem is a way to collect and analyze data in real time. Refers to a wide range of technologies ranging from interconnected sensor-driven microcontrollers to processor-driven devices.

The nature Internet of things does not make one area stand out, but it affects the entire industry, including devices, wireless networks, platforms, and sensors. In IBSG, the number of connecting devices in 2020 will be 50 billion, and the number of connected devices per person will be 6.58. This trend can be predicted that the important service platform of IoT (Internet of Things) will be centered on devices.According to the Korea Smart Home Industry Association, the domestic smart home market sales in 2015 were KRW 10,375.7 billion, up 21.1% from KRW 8,569.7 billion in 2014. These trends are continuing to grow at an annual rate of around 20%, and by 2018, the market is expected to double to nearly 19 trillion won[6,7].

If the existing Internet is a technology that connects people and computers, and M2M has made connections between things, the Internet of things is creating a super connective era that interconnects people and things[8,9]. As shown in Figure 2, the Internet market for materials is showing rapid growth and forecasts 50 billion markets by 2020.

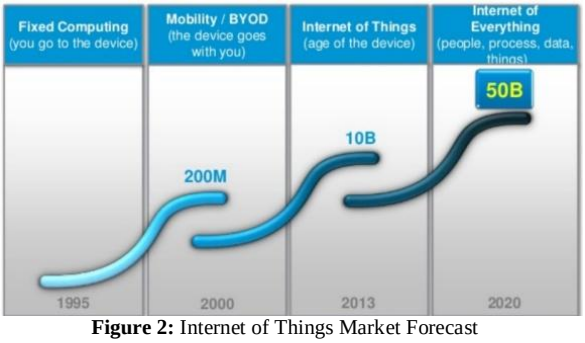

Figure 2: Internet of Things Market Forecast

Worldwide IoT related services and software fields are expected to show high growth as well as hardware such as networks and terminals. In addition, by 2019, IoT services and software are expected to grow at a CAGR of 44%[10].

2.2. Energy IoT Technology Status

The case of complex fusion for efficient allocation and management of energy resources is being activated. In particular, the electric energy field is actively engaged in the demand and response system sector by integrating various information of the generator output, current power grid load, electric vehicle and smart equipment based on the Internet of things.

Currently, Internet-based solutions for smart home related things such as housing, home appliances are ongoing. Domestic large corporations are concentrating on constructing new service combination type IoT ecosystem, especially smart home of construction sector[11]. HomeChat, developed by LG Electronics, is one of the leading IOT home appliance companies in Korea. It can send commands directly to household appliances equipped with IoT function such as air conditioner, washing machine, refrigerator, oven. In addition, it is linked with Nest Thermostat (automatic thermostat) so that the optimal temperature, humidity, and cooling can be controlled automatically. In addition, the smart home provided by Samsung provides services by linking management devices such as dynamic lighting operation, home automation, energy management, security, and health status monitoring to smart devices[12,13]. In other words, it is possible to check and control the status of most of the devices in the house from an external device.

AT & T has launched its 'Digital Life' service, which provides security monitoring and home control. It uses a smart phone or tablet to operate the security camera, temperature controller, door lock, etc. installed in the home. It was implemented as a nationwide service based on mobile, and unlike existing carriers, it actively accepted partnerships and third parties to provide a hardware-based platform[14]. In addition, home security services are differentiated by services that are similar to those of professional security companies by combining on-line and off-line services. Figure 3 shows AT & T's smart home security system.

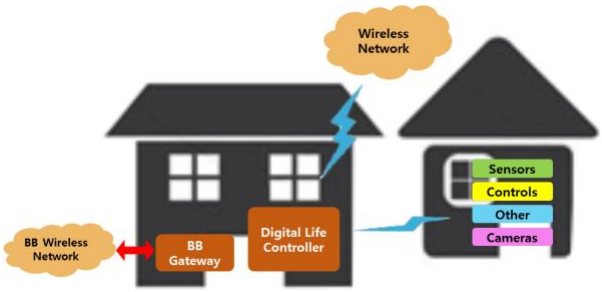

Figure 3: AT & T's smart home security system

Many of the IoT development and application examples at home and abroad have continued to lead to their platform. Media reports and product announcements are growing with public interest. In combination with mobile, cloud and big data, the market for IoT is gradually expanding. In the future, it has a goal to preoccupy global competitiveness. At present, research and development of IoT technology is continuously developing and various IoT products are expected to come out. In particular, large corporations and telecom companies are trying to secure their customers' competitiveness by constructing ecosystems within a limited platform with various companies through its IoT platform service[15,16].

If IoT technology is developed in such a situation, the environment is likely to become fixed and the possibility of a unique solution is low. In other words, it is necessary to develop and apply various remote power management and control solutions that can't be recognized only by specific devices so that they can be applied to a wide variety of devices. In addition, recently developed remote power management and control solution is a method of controlling through an internal router. Therefore, if there is an internal firewall, a complicated network configuration is required, so that the access path is limited.

The remote power management and control solution using the Internet must have the WOL(Wake On Lan) function on the user's device, and the user must turn on the WOLfunction on the device, perform the router setting and network setting, and then remotely. Therefore, in this paper, we designed a system that enables users to easily turn on / off the power of the device remotely without complicated setting.

3. System Design

In this paper, we have carried out research to realize the next generation power management and control solution environment. For this purpose, remote power management and control system of IoT devices using remote control advanced technology was designed. The goal of the proposed system design is to remotely control the IoT device remotely from outside by simply setting it without any setting even in the presence of an internal firewall. In particular, we designed a system that controls the power of IoT devices without having a public IP address under any network

conditions.

In this paper, we designed the system functions in detail as follows in order to perform remote control without setting the environment separately. First, the target terminal is remotely controlled from the client terminal to the target terminal via the main server and the hub server, and remote control is performed on the target terminal. Second, in the internal firewall environment, power is remotely requested to the target terminal via the server. Third, the remote connection of the target terminal is possible in the hub server, and the function is designed to link the target terminal by installing the separate hardware.Finally, it is necessary to design the platform central server system module by module. To this end, a platform central server was composed of anCertification server module, a Translation server module, and a management server module.Figure 4 shows the configuration of the proposed platform central server system module.

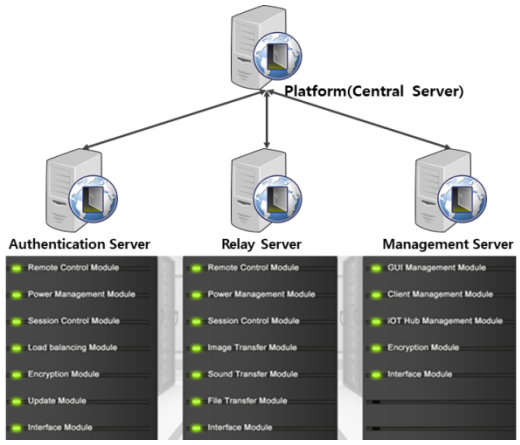

Figure 4:. Platform central server module configuration diagram

In order to manage the power of IoT device remotely, it is designed to link the remote connection from the outside to the central server, the hub terminal and the client PC (server). The central server consists of a Translation server system and a server management system after being connected to an external access Certification system for remote power management and control of the client PC terminal.

In the Certification server system, the user accesses the central server from the outside in encrypted form and proceeds the user Certification through the Translation server and the management server of the central server.Figure 5 shows the Certification server system module design.

① Develop a Remote Control Module, a module that remotely accesses and controls the central server.

② Develop a Power Management Module, which is a module that manages the server PC's power from the central server.

③ Develop Session Control Module, which is a module to create / maintain sessions required for remote access from the central server.

④ Develop a load balancing module, which is a network balancing module to distribute work processes evenly over network load.

⑤ Develop an Encryption Module which is a security module for applying security policy in remote access.

⑥ Develop Interface Module which is an interface module for remote connection.

⑦ Develop Update Module to update automatically when an update event occurs.

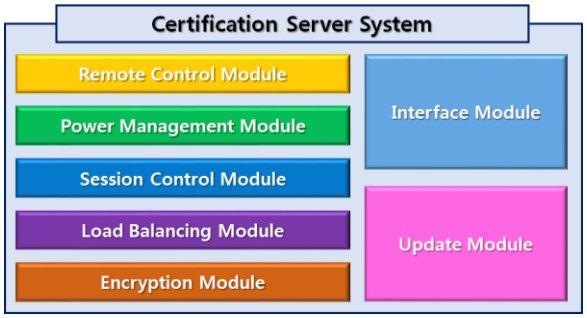

Figure 5: Certification server module

The Translation server system Translations the hub and the central server using the user information at the Certification server.Figure 6 shows the Translationserver system module design.

① Develop a Remote Control Module, which is a remote control module for the Translation server, in the Certification server.

② Develop a Power Management Module, which is a module that manages the server PC's power from the central server.

③ Develop Session Control Module, which is a module to create / maintain sessions required for remote access from the central server.

④ Develop the Image Transfer Module which is the display screen transmission module of the server PC.

⑤ Develop a Sound Transfer Module, which is a module that transmits sound of a server PC.

⑥ Develop a file transfer module which is a bidirectional file transfer module between server PC and viewer PC.

⑦ Develop the interface module which is the module for the interface of the central server.

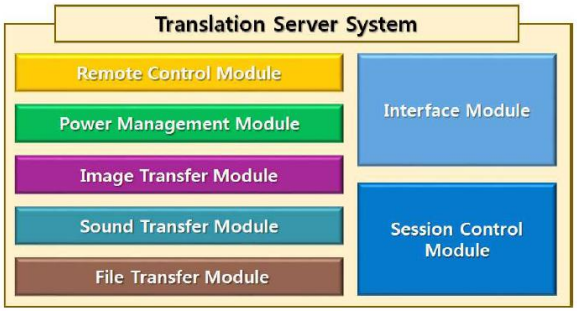

Figure 6: Translation server module

Finally, the management server system is a server system used when a user controls management information of a central server. The management server includes information on the hub level and can manage it. Figure 7 shows the management server system module design.

① Develop a GUI Management Module, which is a module that manages the GUI of the management server.

② Develop a Client Management Module, which is a module that manages client PC (server) in the central server.

③ Develop the IoT Hub Management Module that manages the IoT Hub from the central server.

④ Develop a security module, Encryption Module, when connecting the hub to the central server.

⑤ Develop Interface Module, which is a management system interface module.

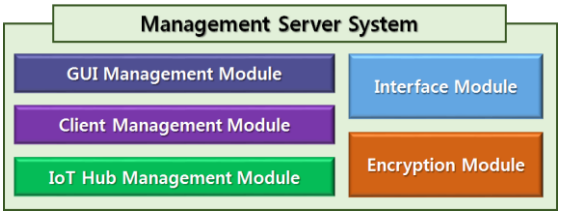

Figure 7: Management server module

4. Conclusion

IoT technology is realizing as internet is developed and general use is generalized. In IoT technology, it is essential that users control and manage the device. To this end, remote power management of the device must be developed and utilized. The existing remote power management technology is complex to set up and difficult to install. Therefore, in this paper, we design a system that can remotely manage and control the power supply easily and simply by remote power management and control technology.

During the system design process, remote control was performed via the main server and the hub server between the client terminal and the target terminal. Also, in the internal firewall environment, the system module is configured to remotely request power to the target terminal via the server. Also, the remote connection of the target terminal can be wired / wireless in the hub server, and the corresponding function is designed to be installed by installing separate hardware in the target terminal.

The platform central server system proposed in this paper consists of three system modules. That is, the platform central server system is designed as aCertification server module capable of remote access through user Certification, a Translation server module connecting the central server and the hub terminal, and a management server module controlling the management information of the central server. Finally, we designed a system that can control IoT devices remotely from outside without having a public IP address and no separate configuration.

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