Agent for Home Server Management in Intelligent Smart Home Network

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Abstract

The intelligent home network system integrates various devices in the home into one communication network to provide information sharing, control, and operation environment between devices. This intelligent home network system operates around a home server. Home appliances in the era of the 4th industrial revolution will have numerous home servers in logical areas as the intelligent home network in the home accelerates. Therefore, the need for systematic management of home servers is emerging. We propose an agent system for efficient intelligent smart home server management. The agent system monitors the home server and operating environment for home server management of the intelligent smart home network. By referring to this monitored information, the service module of the home server is managed, and the home server is dealt with whether it is normal or not. In addition, by referring to the information collected by the service agent created in the group management server while migrating the home server, it is possible to deal with integrated meter reading, crime prevention, and topics. And when a new service is applied to the home server, it is registered in the management server and distributed to the home server through the agent, so that the intelligent smart home network can be efficiently managed.

1. Introduction

Currently, in preparation for the 4th Industrial Revolution, the Korean government jointly enacted the 'Intelligent Home Network Facility Installation and Technical Standards' notice [1]. This notice is applied to the case of installing intelligent home network facilities in apartment houses with 30 or more households constructed with approval of the housing construction project plan [2]. In particular, due to the development and dissemination of home appliances, homes with a hyper-connected home network environment are rapidly being formed, centering on intelligent apartments [3]. The intelligent home network environment formed in this way provides a more convenient and richer living environment in the home by connecting numerous IOT devices in the home [4]. Therefore, the IOT devices installed in the intelligent home networked home are integrated management and control through the home server. A home server exists in each home built in such an environment [5]. Therefore, as the number of households to which the intelligent home network environment is applied increases, the number of home servers increases proportionally. If the number of home

servers increases, it should be possible to manage them in a systematic and unified way. In the case of recent intelligent apartments, there is a home server that manages all IOT(Internet of Thing) devices in an integrated way in each home. And a management system called a complex server that manages the apartment complex is built. However, only general services such as device control, status information, and parking management through the community app are provided. These complex servers depend only on management related to the physical area of the complex, and support for home server management is insufficient [6]. In this paper, we propose a mobile agent-based intelligent home network group management. This enables unified, systematic, and autonomous management of home servers under a distributed cloud-based intelligent home network environment. Home server management is managed by HCS (Housing Complex Server), which is a management server. The management server handles the tasks to be serviced by migrating the service agent and event execution data to the home server to be serviced by creating a mobile agent. The structure of this paper is as follows. Chapter 2 describes related work. Chapter 3 describes intelligent home network group management in this paper, and chapter 4 describes agent-based intelligent home network management. Chapter 5 describes the conclusion.

2. Related Work

An agent is a piece of software that performs tasks on behalf of humans. A mobile agent is an object that moves through a predetermined path or autonomously and performs a task through a network [7, 8]. While general networking programs send and receive messages through the network, mobile agents move objects and accompanying data as well. Also, existing programs move to places where large amounts of data are to be processed. However, the movement agent moves the object to the place where the data is and performs the work. An intelligent home network is an intelligent home network [9, 10] that connects home appliances and systems with each other or with information devices on the external Internet so that remote access and control of each device and system is possible, and content such as music, video, data, etc. can be used. It is defined as a technology that implements a forward-looking communication service environment.

3. Intelligent Home Network Group Management

The purpose is to manage, as a group, intelligent home network-based home servers that manage, supervise, and control all digital devices in the home. In order to systematically and consistently manage multiple home servers, HCS is installed to manage home servers. HCS creates the agent required for management, establishes a data migration plan, and stores and manages the data provided from the home book. HCS collects status information of all home servers in the group by migrating the monitoring agent to the home server. Based on the information collected in this way, it is used as the base data to update the service module of the home server and determine whether the home server operates normally. Also, when a new service needs to be added to the home server, the HCS checks the status of all home servers in the group. After that, the Module Update Agent migrates according to the migration path and adds services. If the home server fails, the home server is physically booted from the HCS. After booting, it checks whether it operates normally, stores it in log information, and informs the administrator and user of this information. Since the HCS meter reading agent moves home servers within the group and collects all meter reading information within the server, integrated meter reading is possible, and this meter reading information is utilized as basic data for energy policy. In this paper, we propose an intelligent home network group management structure using a mobile agent as shown in Figure 1. As shown in Figure 1, in the intelligent home network group management structure, there are home servers distributed in a logical area and HCS that manages them. HCS has the functions of agent creation, distribution, data collection, update, migration plan, log management, and service agent management. For the

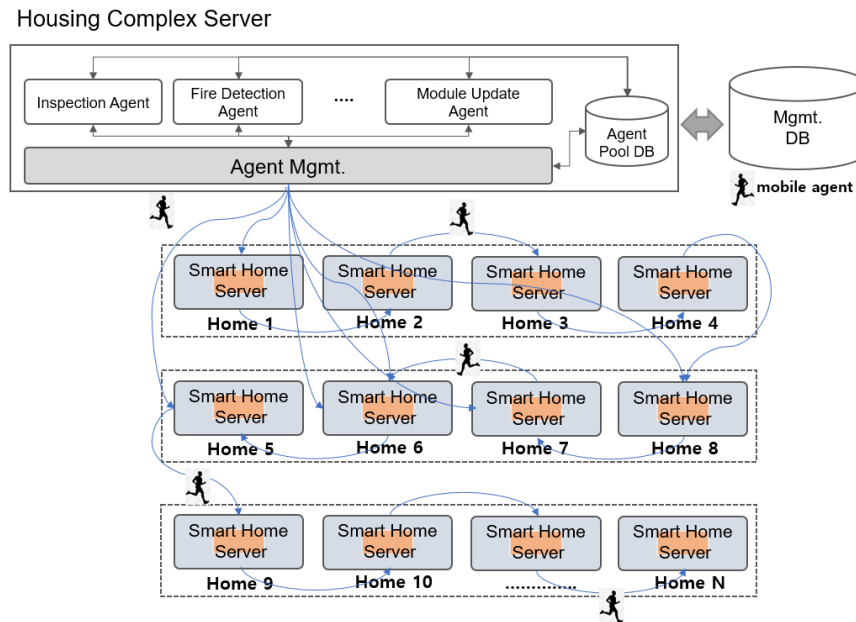details of HCS, Chapter 4 describes the structure of the home server to be managed from the HCS.

Figure 1. Intelligent home network group management structure

4. Agent-based Intelligent Home Network Management

4.1 Intelligent Home Network Group Management Structure

HCS, an intelligent home network management server, is largely divided into two areas. One is the Agent Manager to manage the agent, and the other is the Service Agents part where the actual agents that run the service are stored. All information for managing the agent and home servers is stored in the Management DB, and information on the service agent, version, and event is stored in the Agent Pool. It has the same structure as Figure 2.
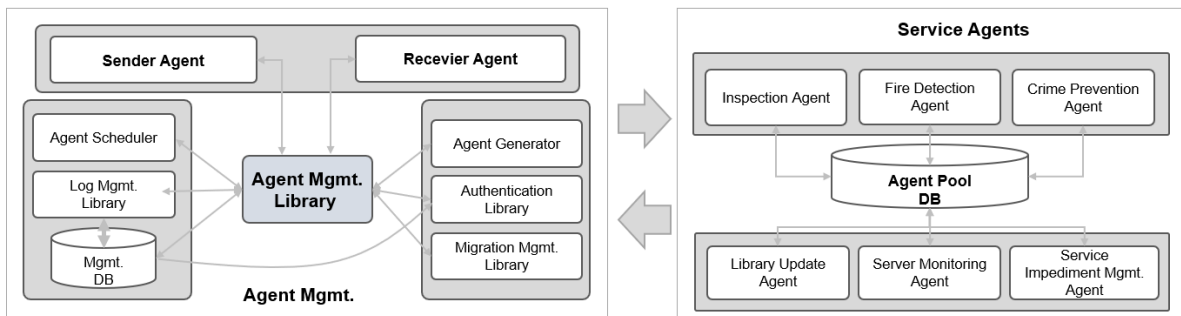

Figure 2. Software structure of agent-based home management server

■ **Agent Mgmt.** The Agent Manager serves as the basis for the activity and execution of agents for group management. Agent Manager consists of 9 functions: Agent Sender, Agent Receiver, Agent Management Module, Agent Scheduler, Log Management Module, Agent Generator, Security Module, Migration Management Module, and Management Database. Agent Sender is responsible for migrating the objectified agent for service to the home server. That Agent Receiver is responsible for running the service and receiving the migrated agent and output. The accepted information is stored in the management DB through the agent

management module. Agent Scheduler creates a schedule for each service agent by referring to the agent management module, management DB information, and agent pool. According to the schedule created in this way, the service agent to be serviced is objectified through the Agent Generator in the agent management module. Then, the migration path is assigned from the Migration Management Module, and the service is executed by migrating to the corresponding home server. The Log Management Module agent analyzes log information retrieved from home servers while migrating and stores it in the management DB. This log information is used as effective information when scheduling an agent or creating a migration path.

■ **Service Agent.** The service agent part consists of the agent pool where each service agent and agent information and service modules and agents operating in the home server are stored. The service agent proposed in this paper consists of six types. Inspection Agent that performs the function of integrated meter reading, Fire Detection Agent that detects fire in the home or responds to fire occurrence. Crime prevention agent that generates events against crime and intrusion from outsiders, and Module Update Agent that can update modules and agents that provide services from home servers in the home. It consists of a Service Monitoring Agent that monitors whether the home server and service agent operate normally, and a Service Impediment Agent that responds appropriately when a home server failure occurs. When a service to be added later occurs, information about the service agent is stored in the agent pool and an environment for extended service is provided by adding an agent to operate in the Service Agents area.

4.2 Intelligent Home Network Group Management Structure

In this paper, the structure of the intelligent home server is proposed as shown in Figure 3. The home server has a middleware part that integrates control of digital devices and an Agent Communication Tuple-Space Manager that manages information sharing between agents. And there is a home information DB (Home Information DB) in which all information in the home is stored. For example, if the inspection agent (Inspection Agent) migrates from the HSC to the Agent Receiver of the home server, the inspection agent issues the inspection command to the Reaction Event. After that, Agent Communication Tuple-Space Manager executes an event command to the meter reading agent in the home server. Home Server Meter Reading Agent Obtains information of meter readers in the home and records it in Tuple-Space. The meter reading information recorded in Tuple-Space is transferred to the next path after Agent Communication Tuple-Space Manager provides results to the meter reading agent that has been migrated from HCS. The agent management module communicates with all modules and provides a function for the agent to perform general policies for normal execution, migration, and information management. The operation process of HCS is shown in Figure 4.
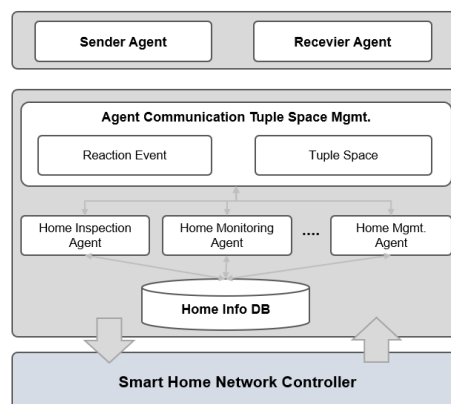

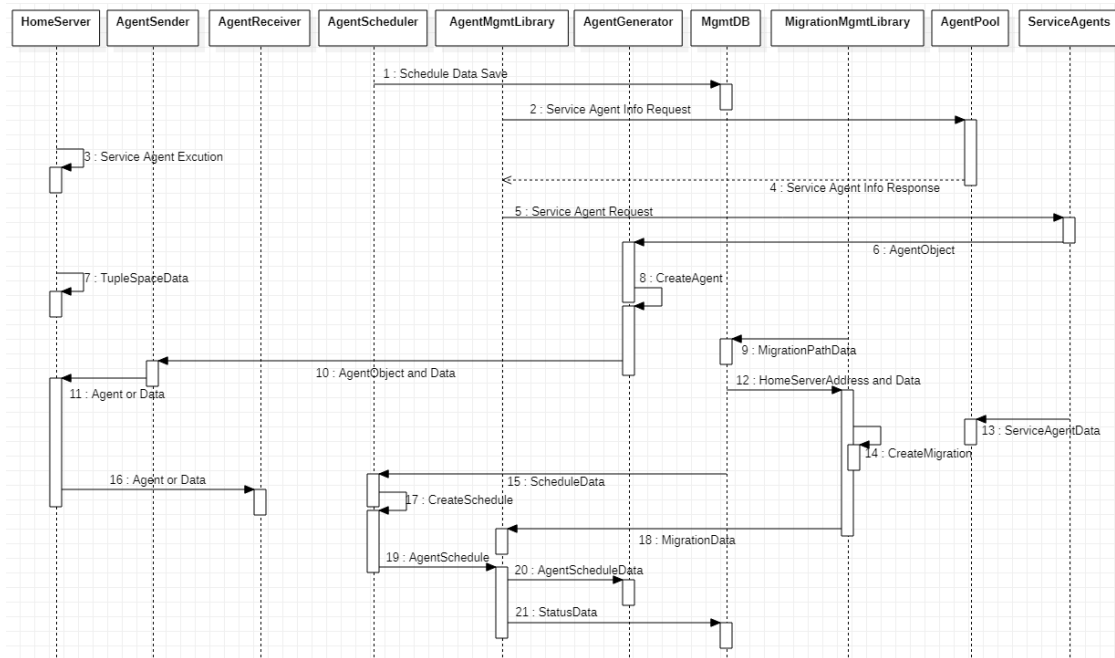**Figure 3. Structure of agent-based intelligent home server**

Figure 4. Intelligent Home Management Server (HCS) Operation Process

5. Conclusion

We present an efficient management using a mobile agent between a home server and a home network group management server HCS. In this way, the home server can be managed systematically and autonomously. In addition, more expanded services can be provided by integrating and managing various home server information in the HCS. Therefore, information can be processed and provided as useful information to users. By migrating and performing the actual processing task to the corresponding home server, it has the effect of increasing the operation efficiency and reducing the network load. It can respond more quickly to the appearance of new services than the existing management. In addition, maintenance is easy because the service module can be modified or reset by frequently checking the status of the home server. For future research, it is necessary to study the security between agent communication, to study agent authentication and verification, and to study intelligent agents in the home network environment.

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