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IoT Distributed Processing System Based on Resource Allocation Algorithm

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Abstract

Recently, IoT (Internet of Things) is being studied to construct a smart environment in cooperation with various devices. However, existing systems are centralized systems that transmit the measured sensor data to the server in real time and process it through the threshold value. As the scale of the system grows, there is a disadvantage that the amount of data the server has to handle increases and you have to configure a high-specification server.

In this paper, we propose an IoT distributed processing system based on resource allocation algorithm to solve this problem. The proposed system does not transmit measured sensor data to the server in real time and confirm the task through the threshold value in the device. When a task occurs, share task with other devices and processing distributed. Request the server for the required resources. Accordingly, it is expected that it will be easy to expand in a smart environment where the resource use of the server is reduced and it changes consistently.

Keywords: Distributed Processing, IoT, Resource Allocation, Task Share

INTRODUCTION

Currently, with the advent of the Fourth Industrial Revolution, IoT is evolving people, processes, data and objects into interconnected intelligent systems and research is proceeding globally. It collects data on the surrounding environment and provides customized services by applying knowledge acquired through user behavior or device communication[1-4]. However, due to the rapid growth of mobile networks, the number of various devices connected to the Internet is increasing, and the data generated by the devices is also increasing exponentially, requiring real-time processing and storage devices[5,6].

Existing IoT systems transmit data measured through sensors attached to the device to the server in real time to determine whether or not the work is done and deliver the command to the device from the server. Because it is a centralized system that handles all the work in the server, there is a disadvantage that a high-spec server that can process a large amount of data needs to be placed as the system is expanded[7,8].

In this paper, we propose a system which distributes the work generated by the device to other devices and allocates resources corresponding to the operation server to solve this problem. The system verifies the occurrence of the work through the sensor data measured in real time and sends the task to other devices in case of task occurrence, and compares. Requests the required resources the server, and the server allocates necessary resources as compared with the existing operations. If the user desires, the device can be operated through the remote control, and the necessary resources are allocated from the server. Therefore, it is possible to efficiently use the resources of the server and configure it as a low-specification server in a management place where the environment continuously changes.

SYSTEM DESIGN

The purpose of this system is to perform sharing, comparison when a task occurs and by setting the final device the necessary resources are allocated from the server. The distributed resource allocation system based on the proposed resource allocation algorithm judges the operation in the device through the measured sensor data. In addition, application monitors the status of the management place current and resource usage, and allows the user to remotely control the device. Figure 1 shows the structure of the proposed distributed resource-based distributed processing system.

The device status and sensor data measurement section is classified as those used in the system, and each sensor data is measured through Arduino. The server obtains the necessary resources through the resource allocation algorithm and transmits the control command to the device. We also load the results into the database to calculate usage and set up operations. The database contains sensor data, usage, and device status. In the service, the user can check the resource usage and can operate the device through remote control if necessary. Figure 2 shows the system flow chart.

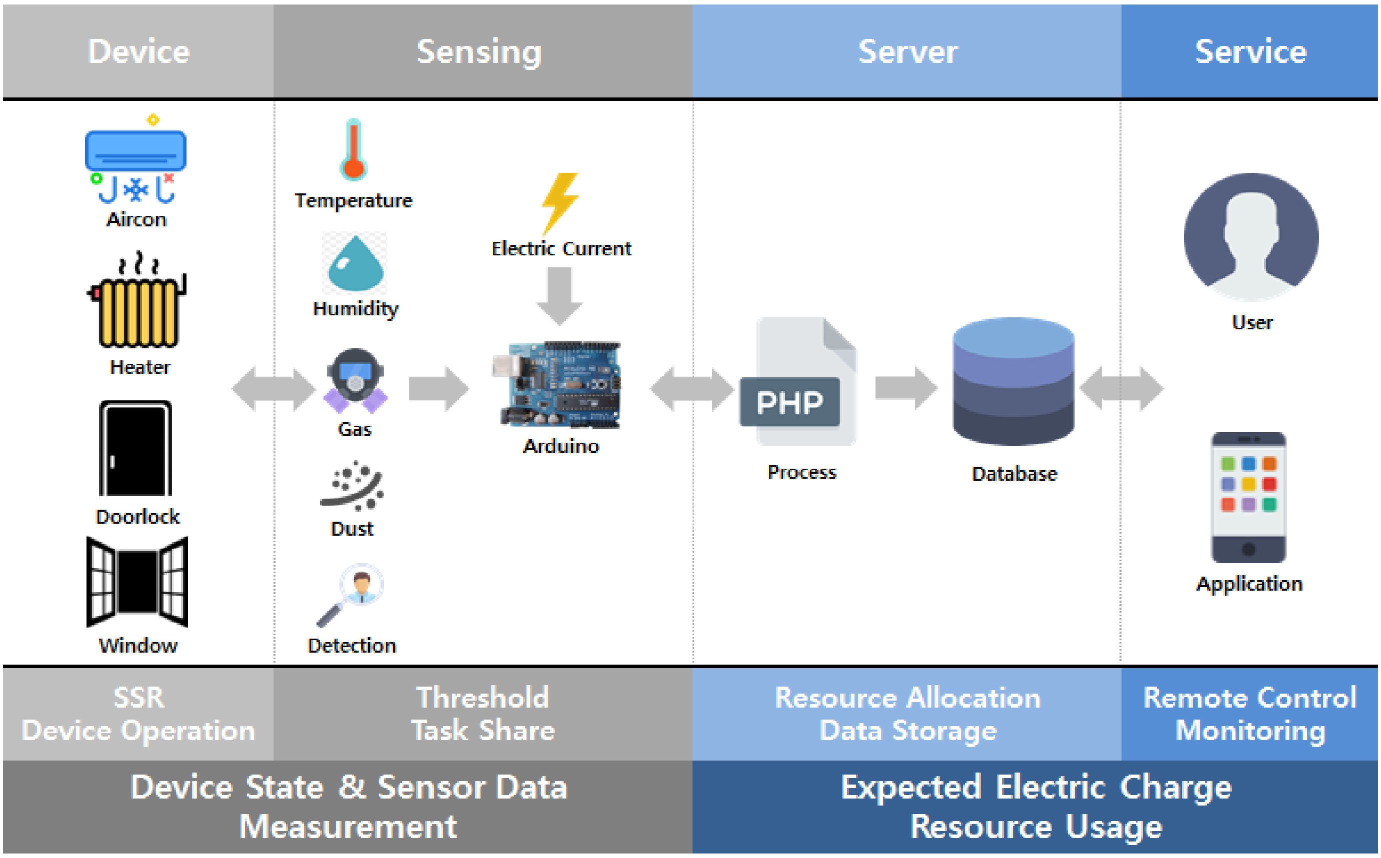

Figure 1: The Configuration Diagram of Distributed Processing System based on Resource Allocation Algorithm

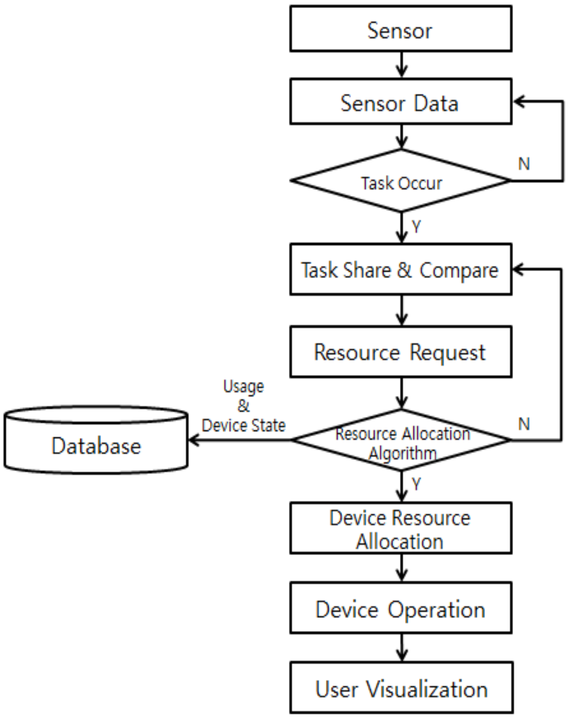

Figure 2: The System Flow Chart

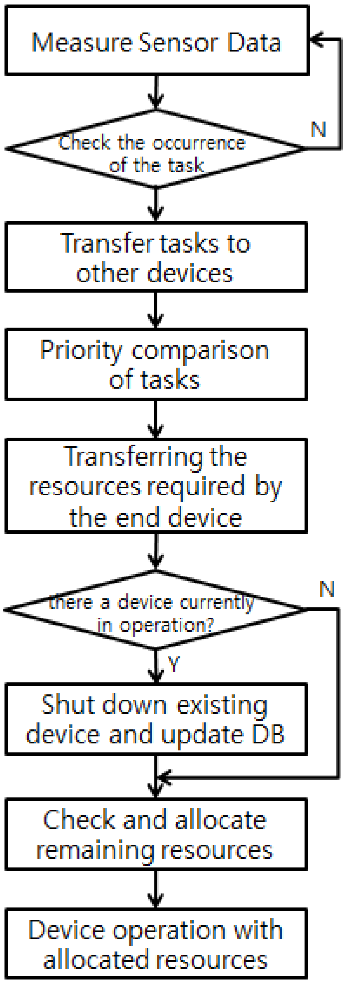

Figure 3: Resource Allocation Algorithm Flow Diagram

Sensor data measured through temperature, humidity, gas, dust, and sensor detects the occurrence of work through the threshold value in the device. When a task occurs, it uses Bluetooth communication to share work with other devices and compares priorities to be operated. After the comparison, the final device requests the resources required by the server, and the server allocates necessary resources to the device through the resource allocation algorithm. It also updates device behavior, resource usage, and power usage status in the database. The final device delivers resources to the device on which it should operate. The updated result is confirmed by the user application. Figure 3 shows a flow diagram of the Resource Allocation Algorithm.

The sensor data confirms whether the operation has occurred through the threshold value. When a task occurs, the task data is transmitted to another device and selected as the final device. In other devices, work sharing is performed, and at the same time, whether or not the tasks are simultaneously generated through the sensor data threshold value is compared and transmitted to the final device. After the comparison with the devices, the final device requests the required resources from the server, and the server confirms whether there is a device currently in operation. If there is an active device, shut down the existing device and update the status of the database. If there is no device in operation, the remaining resources are checked and the allocation to the final device proceeds. The final device operates the device with the allocated resources. Through this process, devices are distributed and resources are allocated and operated to reduce the data processed by the server.

SYSTEM IMPLEMENTATION

This section deals with the implementation of a distributed processing system based on the proposed resource allocation algorithm. Figure 4 shows the application main page and environmental status monitoring page.

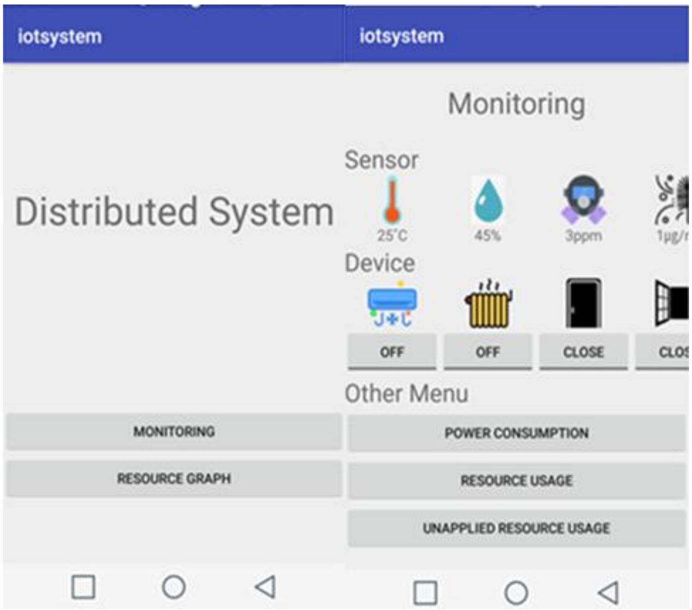

Figure 4: Application Main Page & Environment State Monitoring Page

When the application is executed, the initial screen is displayed. If the monitoring button is pressed, the monitoring page is displayed. The monitoring page updates the sensor data and the status of the devices loaded in the database. ON and OFF toggle buttons to control the devices remotely, and at the same time the button is pressed, the database is updated and the server allocates the remaining resources to the device and sends the operation command. The Other Menu shows the resource usage of the system to which the device-specific power consumption, distributed processing, and resource allocation are applied and the resource consumption of the non-applied system. Figure 5 shows the power usage page for each device.

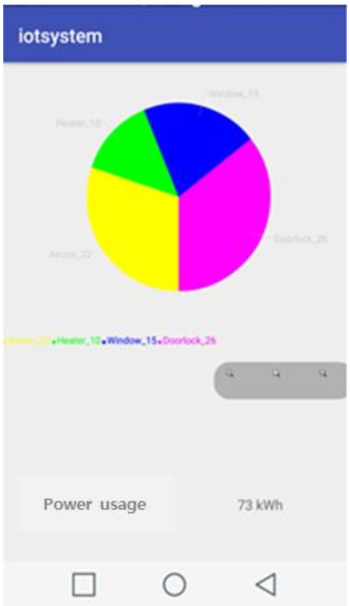

Figure 5: Power Usage Page for Each Device

Figure 6: Prototype of the Entire System

Data measured by the Arduino current sensor is sent to the server and loaded into the database. The database extracts data on the usage of the loaded device, generates it as a graph, and provides current monitoring of power usage. Figure 6 shows the prototype of the entire system

The sensors that make up the prototype of this system utilize five kinds of sensors such as temperature sensor, humidity sensor, gas sensor, dust sensor and human body sensor. The devices that are working are electric fans, heaters, windows, door locks is.

The data measured through the sensor is initiated through the thresholds in the device and the system proceeds through sharing and comparison. The temperature and humidity sensor operate the fan and the heater related to the temperature control, and the gas and dust sensor ventilate according to the gas generation or indoor air quality.

The human body detection sensor confirms whether there is a user in the management place and controls the door lock. Attach SSR (Solid State Relay) to Arduino and control the power of the device through 5V electric signal. SSR can turn on / off the power of the device through remote control or automatic control by user through power control.

REVIEW

In this paper, to solve the problems of the centralized system in the IoT environment, we conduct the operation judgment by the sensor data in the device and reduce the data processed by the server by sharing the operation with other devices. Table 1 shows the dataset for the experiment.

Table 1: Experiment Data Set

Data Set	Description
Centralized System	Temperature = 27℃ Humidity = 50% ~ 60% Device = Aircon(Auto Control) Data processing = Server
Development System	Temperature = 27℃ Humidity = 50% ~ 60% Device = Aircon(Auto Control) Data processing = Arduino

The data set used in the experiment is an experiment on the automatic operation of the device in the centralized system and the proposed system using distributed processing. Figure 7 shows the resource usage graph

Both systems were run through the same server's specifications, with the same threshold for temperature and humidity, configured to operate the air conditioner, and the corresponding resource usage was measured.

The centralized system transmits the data measured by the sensor to the server in real time and judges the occurrence of the work through the threshold value.

In addition, there is a lot of data that the server processes because it identifies in the server whether other jobs are working. On the other hand, the distributed processing system determines the operation through the threshold value in the device and communicates the result to the server after completing the comparison of all operations through the job sharing with the other devices. It reduces the data throughput of the server because it operates by allocating only the necessary resources.

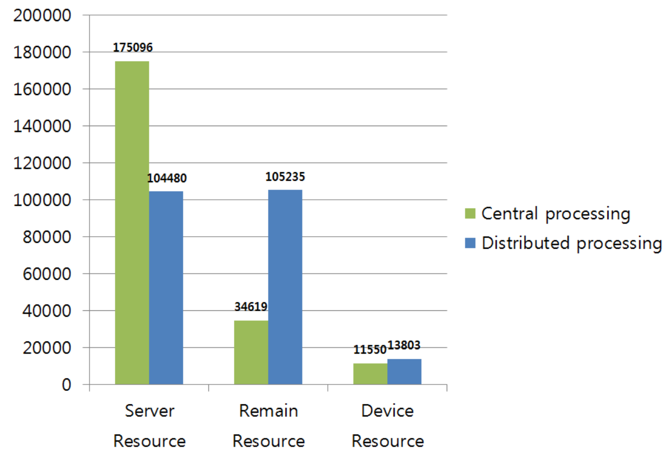

Figure 7: Resource Usage Graph

CONCLUSION

In this paper, we propose a system that distributes the tasks that occur and distributes them automatically and allocates necessary resources and operates automatically. In this system, the data generated by the sensor is judged through the threshold value, shared with other devices, and distributed processing is performed. In other devices, the task comparison is performed according to the priority, and the server requests the necessary resources, and the server allocates necessary resources and updates the status in the database.

This reduces the data throughput of the server and reduces unnecessary work because it allocates resources in comparison with existing operations in the server. By allocating only the necessary resources, you will be able to add more devices and manage the corresponding tasks on servers of the same specification. Future research will should experiments for verification of efficiency in various environments and feedback should be done.

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