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SMART HOME USING ARTIFICIAL INTELLIGENCE

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Abstract-

In this fast age everything becoming an smart to ease the life of human being, similarly homes can also be made smart by using artificial intelligence and internet of things. By using internet of things the device operation and their control technology in smart homes has been attracting attention. The smart home system manages smart devices used in homes, and it provides only the status value information and control function of the currently registered devices. Thus, unnecessary access procedures occur due to the characteristic of the smart home, which uses a smart device repeatedly for the same purpose. To resolve such problem , in this paper, the Smart Home System has been designed, which can predict and suggest users the next steps to take by user usage pattern analysis and inference via machine learning.

Keywords—IoT, Smart home system, TensorFlow, Machine learning

INTRODUCTION

The smart home manager system manages smart devices used in homes, and it provides only the state value information and control function of currently registered devices [3].However, due to the characteristics of the smart homes, which repeatedly uses the smart device for the same purpose, this unnecessary access procedures waste energy. Therefore, in this paper, the Smart Home System that predicts the user's intended activities beforehand, and minimizes unnecessary access procedures via machine learning using TensorFlow's Logistic Classification algorithm, is designed.

ARTIFICIAL INTELLIGENCE

Machine Learning

Machine learning is a way of training a machine so that the computer can be intelligent like humans [4]. At the initial research stage of the machine learning, the studies were carried out for simple data classifications; now it has developed into Decision Tree, Bayesian network, Support Vector Machine and artificial neural networks [5].

TensorFlow

The Provided by Google, TensorFlow is an open source machine learning library that supports various learning algorithms such as reinforcement learning, as well deep learning [6]. Matrix calculations and Convolution in TensorFlow are performed using symbolic graphs, and users can generate them without being constrained by back-propagation implementation of complex neural network structures. The interface provides embedded Python and C/C++ language, and this is advantageous in environments where speed is crucial [6].

DESIGN OF SMART HOME SYSTEM

Smart Home System Overview

Define In recent years, the explosive increases in connectivity devices that constitute smart home IoT are accelerating the development of IoT device management systems. However, the existing system provides only a one-dimensional service that provides registration and deletion of IoT devices, control between devices and IoT state information. Thus, in this paper, the Smart Home System is designed and implemented, which lets devices to machine learn user-patterns by applying the Logistic Classification algorithm based on an open platform,

TensorFlow; and then it suggests beforehand, via inference of user behavior. Figure 1 is an overview diagram of the Smart Home System.

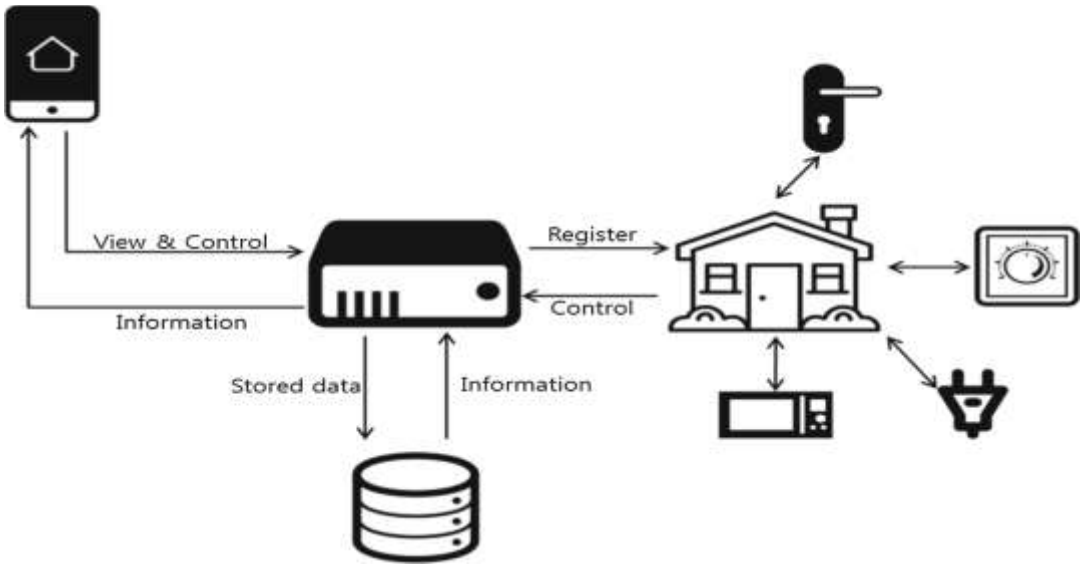

Figure 1. Overview diagram of Smart Home Syatem

Design of Smart Home System

The Smart Home System system is composed of a user-screen and an administrator-screen. The module for the user-screen is designed to allow inquiries into registered IoT devices, and registration, modification, and deletion of user-specified device groups. The module for the administrator-screen is designed to register, modify and delete user information, IoT device information and basic rule information that will be used in machine learning. The structure of the Smart Home System menu is shown in Figure 2.

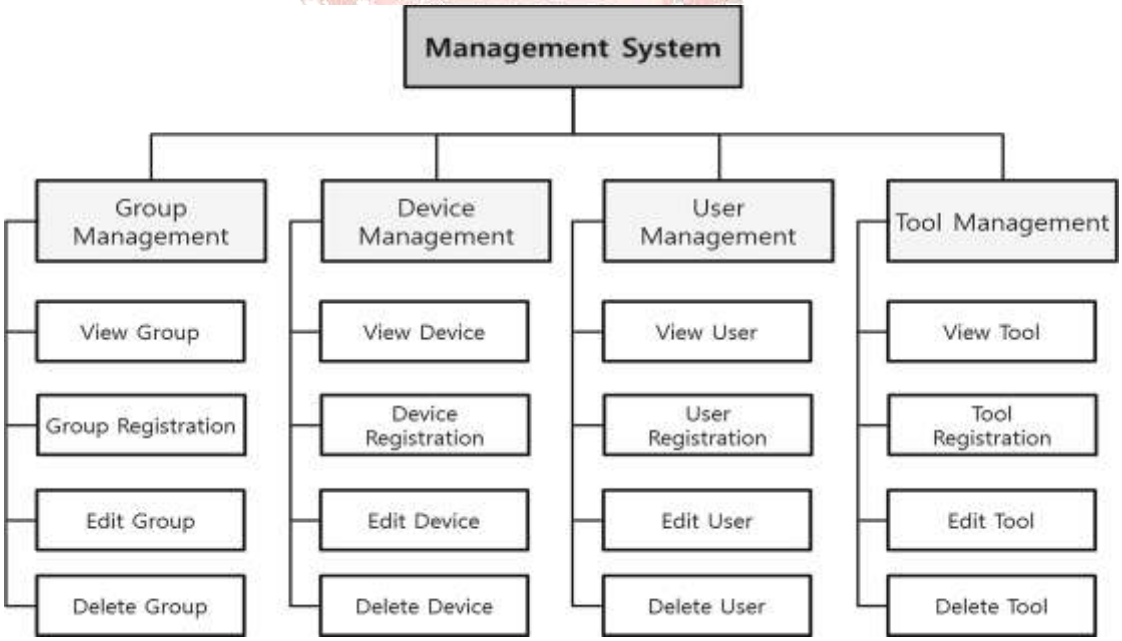

Figure 2. Structure of Smart Home System menu

In the database of the Smart Home System, tables are set up so the user can access device usage information, group information, and rule information based on ID and Home No. The ER Diagram of the Smart Home System is shown in Figure 3.

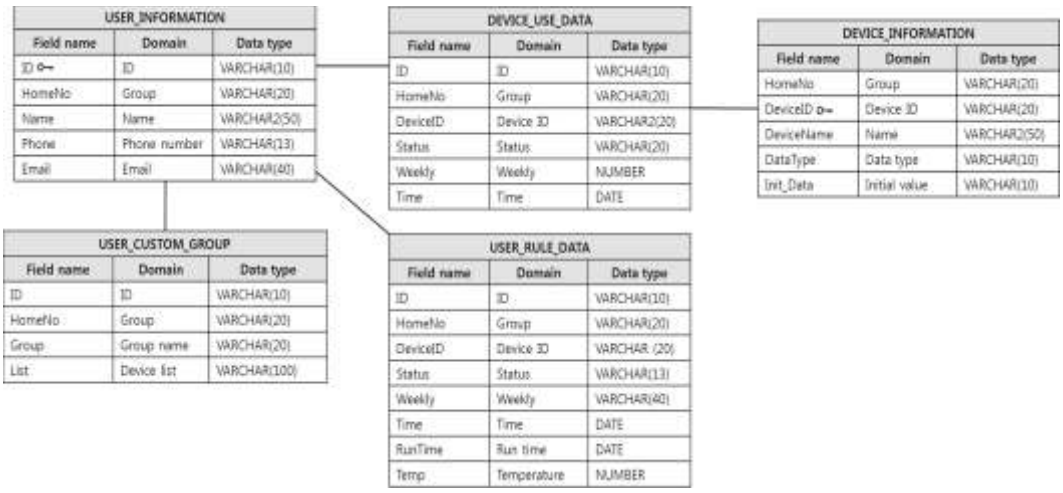

Figure 3. ER diagram of Smart Home System

DESIGN OF SMART HOME SYSTEM ALGORITHM

To implement the Smart Home System, a user behavior pattern analysis algorithm has been designed, which analyzes IoT device usage information and then predicts and suggests user behavior. The behavior inference algorithm via usage pattern analysis is shown in Figure 4. When the user requests information, the system checks the access right of the user and inquires about the usage history of IoT device after the authentication procedure. By machine learning the usage history of IoT devices, optimized hypothesis function is obtained, and IoT device information is inquired in an array form. The change probability is calculated by inputting the current state value into the data trained via the loop statement, and in the case of the device with the valid probability value, it is added to the suggested list. It repeats as many times as the number of devices inquired, and calculates the probability that the device will change and then adds it to the list. When all devices are checked, the suggested list data and current IoT device information are delivered to the user. In addition, it is implemented to learn IoT device usage history via the Logistic Classification algorithm.

Design of TensorFlow-Based Smart Home System

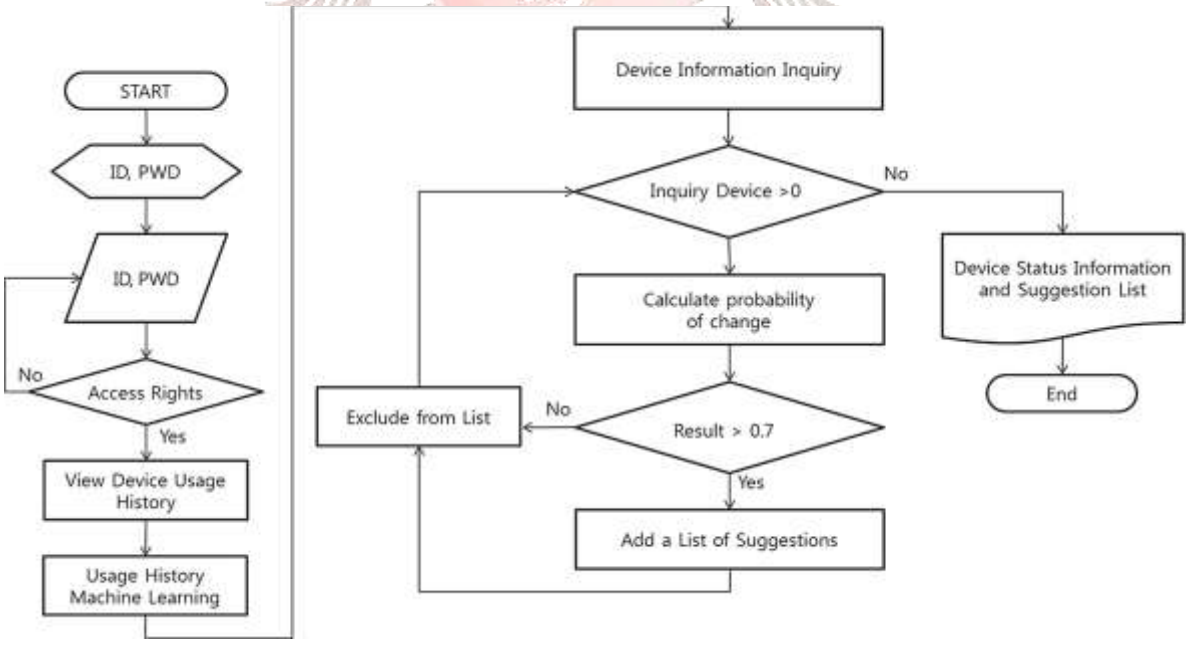

Figure 4. Behavior inference algorithm via usage pattern analysis

When a device usage history data in the form of matrix type are transmitted, 'W' which minimizes the cost function c(w) between a hypothetical function, H (X) and distributed data is found through learning.

$$H(X) = \frac{1}{1 + e^{-WTX}}$$

$$c(W) = -\frac{1}{m}\sum y\, log\big(H(x)\big) + (1-y) log\ (1-H(x))$$

$$W = w - a\frac{\partial y}{\partial x}$$

Where, y=cos(w) Figure 5 shows the implementation of the Logistic classification algorithm via the TensorFlow API.

CONCLUSION

Due to the advancement of science and technology and the popularization of smart devices, we are now entering a new era of the IoT, in which 'things' i.e., products can control and use other 'things' via internet networks. The markets for smart homes, therefore, are naturally attracting attention as well, and communication companies and construction companies in Korea have started to service IoT device managements. However, at this time, smart home management services do not minimize steps required for each control item because they only provide state value information and control functions for the registered IoT devices. Therefore, in this paper, an active manager, the 'Smart Home System' is proposed, which can minimize the steps users have to go through by analyzing the user behavior patterns and by inferring the information about the IoT devices that users want to control.

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