Visual perception and deep learning in smart homes and the Internet of Things

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Abstract. In recent years, IOT (Internet of Things) has been widely used in the field of smart homes. IOT technology is an important stage in the development process of the "digital information age", with a history of more than ten years of development. It is widely used in the communication industry, especially in the field of smart homes. The basic principle of DL is to establish a multi-layer neural learning network, which learns a large amount of data to obtain better features and improve the accuracy of classification and recognition. This article conducts research on the visual perception of smart homes based on DL (Deep Learning) and IOT. Utilizing an intelligent gateway to achieve the mutual conversion of the underlying ZigBee protocol and in ternet protocol, the cloud service platform is interacted with by the Netty middleware and gateway. The entire system is centered around the Internet cloud platform, connecting the underlying IOT devices and the mobile network platform of the application layer to achieve the construction of a smart home system. The device then collects the user's EEG signals in real-time and hands them over to a trained specific network for classification. Finally, based on the classification results, the serial device sends signals to the smart home terminal to achieve the final practical operation actions, such as turning on the lights and fans.

Keywords: Smart Home, Internet of Things, Visual Perception, Deep Learning.

1. Introduction

The rapid development of Internet information technology has promoted the progress of IOT technology and the improvement of people's living standards. Smart home is based on residence, which integrates various devices in the home with computer science and technology, automation technology, wireless communication technology and integrated wiring technology, and establishes an intelligent living environment with functions of lighting control, home appliance automation, safety monitoring, heating control, telemedicine, home office and intelligent audio-visual entertainment [1]. IOT is an important part of the new generation of information technology. As the name implies, "IOT is the Internet where things are connected". Therefore, the definition of IOT is a kind of network that connects any article with the Internet according to the agreed agreement through information sensing equipment such as radio frequency identification, infrared sensor, global positioning system and laser scanner, and carries out information exchange and communication, so as to realize intelligent identification, positioning, tracking, monitoring and management of articles [2]. IOT technology is an important stage in the development of "digital information age", which has a history of more than ten years now, and is widely used in the communication industry, especially in the field of smart home [3]. There are different opinions about the definition of IOT. International Business Machines in the United States gives the definition of IOT from the perspective of smart earth, while EPC gives the definition from the perspective of radio frequency technology. In China, Chinese Academy of Sciences gives the definition of IOT from the perspective of sensor network. DL is a multi-layer neural network algorithm, which has good learning performance. The original purpose is to make the machine have similar learning ability to human beings. Each individual unit in DL is connected by weight, and the weight is trained through the network [4]. The basic principle of DL is to establish a multi-layer neural learning network. By learning a large amount of data, better features can be obtained, thus improving the accuracy of classification and recognition. This paper studies the visual perception of smart home based on DL and IOT. A network that connects any object with IOT according to a predetermined protocol to communicate, so as to realize intelligent

identification, location and tracking. The core of IOT is to expand the Internet into real life, so that users can better manage the network [5].

2. Intelligent Home System Based on the Internet of Things

2.1. System function

Wireless sensor network is the core technology and hot research direction of IOT, which has attracted widespread attention from academia and industry. The nodes in wireless sensor networks are distributed in specific areas and are a collection of numerous distributed nodes. These nodes have the same characteristics: small size, affordable price, power supply, and limited energy. Zig Bee technology in IOT technology has the characteristics of low speed, low power consumption, self-organization, self-recovery, and bidirectional communication, and has been reused in smart home systems and indoor positioning technology [6]. Zig Bee is able to manage its own network layer well, ensuring secure data transmission. In home networks, network signals can remain stable, and through routing nodes, the transmission range of the network can be expanded, the depth of the network can be increased, and the activity of the network can be maintained. Mainly suitable for the fields of automatic control and remote control, it can be embedded into various devices. This chapter applies IOT to smart home systems for research. The smart home system mainly includes local control and remote-control functions, which can support various remote-control devices, such as computers, mobile phones, telephones, etc. The local device support types include various IOT detectors, home appliance control terminals, etc. [7]. Equipped with a control and management platform, capable of managing users, terminal devices, etc. User management includes user account opening, account cancellation, suspension, validity period, etc; Terminal device management includes device status, fault status, fault information, etc. The structure of the home gateway device is shown in Figure 1.

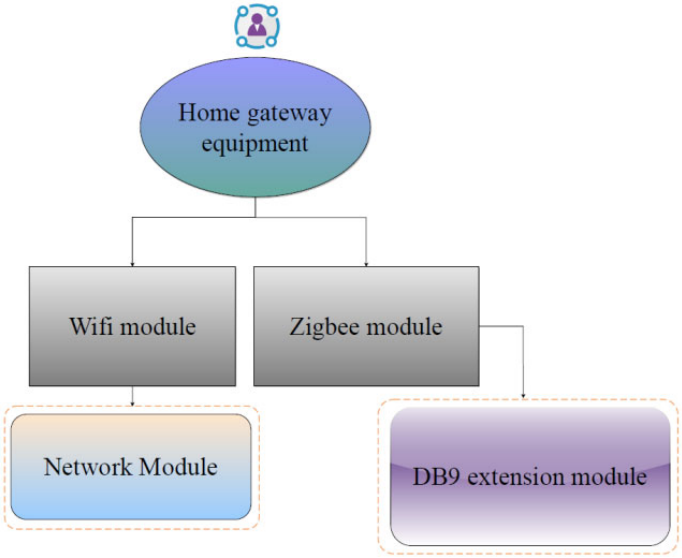

Figure 1. Home Gateway Device Structure

The structure of the home gateway device mainly includes the following modules: (1) Network module: responsible for digital network communication with platforms, including the establishment of communication channels and the analysis of communication instructions, using wired network access. (2) ZIGBEE module: responsible for establishing the ZIGBEE network, establishing network communication with ZIGBEE detectors and ZIGBEE terminal controllers through the ZIG-BEE network. (3) WIFI communication module: responsible for WIFI communication and providing WIFI wireless connections for home gateways. Unified access servers provide access services for terminals and implement load balancing mechanisms to ensure load balancing of backend application servers. The application server is load distributed by the access server and provides functional services for terminal devices and system control devices. The mobile application server is associated with the

application server and access server, and the load is distributed by the receiving server and provides functional services for the mobile terminal [8].

① Overall functionality

Through the intelligent control of the system, the system controls and manages the corresponding equipment based on the perception results of various detectors arranged.

② Front end system functions

Provide contact for IOT detectors, mainly for ZIGBEE devices such as temperature sensors, humidity sensors, light sensors, wind sensors, etc. Provide contact for sensing devices above 5O.

③ User self-service system functions

Users can control various terminal devices through various network devices, such as single device control and scene control.

④ Platform system business functions

Provide user management functions, including user registration, suspension, cancellation, billing, payment, etc. Provide device management functions, including device status management, fault management, upgrade management, etc.

2.2. Research on Visual Perception of Smart Home in Internet of Things

In the existing smart home system solutions, there is still a great lack of the stability of the networking technology in the sensing layer, and in the installation process of the traditional smart home system, technical maintenance personnel need to reasonably design the wiring mode of the wall according to the actual residential type, which has an impact on the service life of the wall to a certain extent [9]. A complete smart home system mainly consists of four parts: ZigBee terminal node, intelligent gateway, cloud service platform and intelligent control terminal. The communication bottom layer adopts the traditional IOTZigBee technology to realize the network construction. The intelligent gateway is used to realize the mutual conversion between the underlying ZigBee protocol and the in-Internet protocol, and the cloud service platform is interacted by netty middleware and gateway. Users only need to access the cloud service platform to realize the control of home devices. The whole system is centered on the Internet cloud platform, and the smart home system is built by connecting the underlying IOT devices and the mobile network platform of the application layer. Once all the terminal nodes and routing nodes have joined the ZigBee network, the whole smart home ZigBee network has been formed. Because of the existence of routing nodes, the stability and activity of the whole network have been greatly improved, and users can experience the real-time transmission of ZigBee network in two directions [10]. The traditional smart home system needs a series of comprehensive wiring, complicated system setup, installation and debugging, which greatly increases the time and labor costs, and it is also difficult to update and upgrade. The smart home system based on ZigBee takes the cloud service platform as the center, and establishes the connection center between the mobile terminal and the underlying communication platform. Through ZigBee network, the electrical equipment in the home is organically organized in a wireless way to form a complete system, so as to realize seamless perception and management. Moreover, the cloud service platform saves a large amount of data information, which is convenient to establish its own big data platform and points out the direction for the future development of smart home.

3. Visual Perception Analysis of Smart Home Based on Deep Learning

3.1. Division of visual hierarchy

We divide visual perception into low-level visual information layer and high-level visual information layer according to the information collected by the bottom sensors and the information processed by the upper application services. According to the basic degree and complexity of vision, low-level vision can be regarded as fine-grained vision, high-level vision as coarse-grained vision, and application services are more concerned with coarse-grained scenarios. The description of the

bottom data is detailed and scattered, and the upper services judge the matching degree of scenarios by fuzzy uncertain natural language, so it is necessary to transform the fine-grained scenarios at the bottom into coarse-grained scenarios at the top and provide them to the top application services for ontology service recommendation.

Get the data from the bottom sensor, and get the low-level data information L through calculation and reasoning:

$$L = M_{D-L} \tag{1}$$

Through the intermediate service layer, the obtained low-level data information L is further reasoned and processed and converted into high-level data information H:

$$H = M_{L-H} \tag{2}$$

The application service layer performs matching and service recommendation through the obtained advanced data information H:

$$S = M_{H-S} \tag{3}$$

Therefore, the mapping reasoning represented by M_{H-S} is divided into three parts, which are scattered in the whole model, thus alleviating the problems of low efficiency and insufficient ability of direct processing.

In the online part, the same equipment is used to collect the user's data, and the data set with the same specifications as the offline experiment is used to train the planned super-parameter network. Then the equipment collects the user's EEG signals in real time and sends them to the trained specific network for classification. Finally, according to the classification result, the serial device sends a signal to the smart home terminal to realize the final practical operation, such as turning on the light and turning on the fan.

3.2. Reasoning Mechanism of Smart Home Based on Deep Learning

Reasoning mechanism is of great significance to the construction of smart home situational application services. Neural network is a computational model that imitates the working principle of human cranial nerves. A large number of simple neurons are used to form a network to realize large-scale complex calculations. As shown in Figure 2, the structure diagram of neural network is mainly divided into input layer, hidden layer and output layer, in which the number of hidden layers and nodes determines the complexity of the whole network. The main advantage of neural network is that it can describe and reason complex situations by training and learning with a large number of samples without prior knowledge.

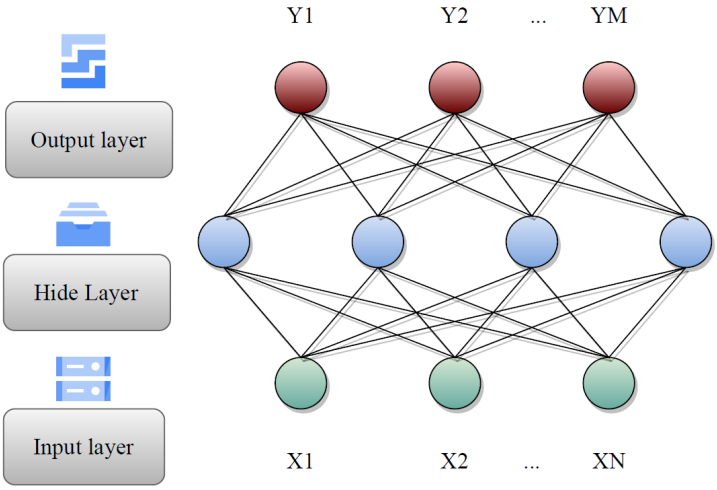

Figure 2. Neural Network

The DL architecture consists of multiple layers of nonlinear computing units, with each lower-level output serving as the input for the higher level. The input data is processed in layers, and each layer of neural network is used to extract different levels of features from the original data, thereby achieving perfect scene matching in the final state. This approach can improve the stability of the network to a certain extent. Under normal network power supply, this method can meet the needs of users. However, in the event of a power outage or intermittent power outage, the coordinator will repeatedly switch on and off again. As the previously saved data information has not been saved, the coordinator cannot find any effective geographical location of the target node after powering on, and cannot establish a communication link with it. Divide a specific smart home scenario into several simple scenarios for analysis. Starting from low-level scenarios, infer higher-level scenarios. Starting from unsupervised initialization-based learning, perform scenario analysis and inference layer by layer, using low-level scenario data as input for the next level of scenario analysis. Continuously compare with preset scenarios, and fine tune the gradient descent of deep trust networks.

4. Conclusion

China's IOT has ushered in a high-speed development tide, and smart homes have also emerged with the tide of IOT. A large number of smart home manufacturers have emerged, with exhibition halls, demonstration sites and exhibitions everywhere, which has a good development prospect. In this paper, the smart home system proposed by operators, based on IOT technology, can meet the operational requirements of telecom, mobile, China Unicom and other operators, focusing on the three advantages of digitalization, integration and platform, with operational characteristics. Based on DL's visual perception analysis of smart home, the description of the bottom data is detailed and scattered, and the upper service mostly judges the matching degree of the scene through fuzzy uncertain natural language. In the smart home system solution, there is still a great lack of the stability of networking technology in the sensing layer. Moreover, in the installation process of the traditional smart home system, technical maintenance personnel need to reasonably design the wiring mode of the wall according to the actual residential unit type, which has an impact on the service life of the wall to a certain extent. After the improvement of this paper, it can bring better intelligent experience to users. However, in the large-scale network, the network environment is more complex and the factors affecting the network may increase, so the algorithm needs further discussion and improvement.

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