Design of Plant Breeding System Based on oneM2M Standard

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Abstract. With the continuous upgrading of the Internet of Things, cloud platform and intelligent control technology, the development of plant cultivation has become intelligent. Aiming at the problems of low intelligent degree of environmental monitoring, in this paper, combined with agricultural Internet of Things, a plant cultivation system based on oneM2M platform was designed and developed. In addition, this paper takes succulent seedlings as the experimental object and designs a succulent seedling cultivation system to achieve the control expectation of this plant cultivation system.

1. Introduction
The Internet of Things (IoT) is regarded as another wave of informatization, which is widely used in many fields. The Internet of Things (IoT) is a technology that collects real-time information of any object that needs to be monitored, connected and interactive through underlying devices, realizes ubiquitous connection between objects and objects, and between objects and people through all kinds of possible network access nodes, and realizes intelligent perception and management of objects. However, the IoT market is suffering from vertical fragmentation, with various vendor-specific IoT solutions designed independently for specific applications. To address this challenge, eight of the world’s most important telecommunications standards development and development organizations (SDO) established the oneM2M Global Partnership Program, which aims to provide a common architecture for cross-domain interoperability of the Internet of Things in terms of communication and semantic data, namely the oneM2M Standard Common Architecture. Therefore, the oneM2M standard can meet the need of connection management for agricultural IoT.

There are strict requirements for environmental factors such as air temperature and soil temperature and humidity during plant cultivation. But in traditional plant cultivation, people mostly choose to observe the growth environment of plants based on past experience and artificial measurements. The results of this crude monitoring method are imprecise and require a lot of manpower and resources. To solve the above problems, we use Internet of Things technology to propose the design of plant cultivation system based on oneM2M standard. Through the visual interface of the web end, users can know the environmental conditions of plant growth in real time, and realize the automation/manual intervention control of the underlying equipment through simple operation instructions. Therefore, the system has important economic and social value.

This paper will take succulent seedlings as the experimental object, and design a succulent seedling cultivation system based on oneM2M standard. During culturing of succulent seedlings, soil moisture sensors and temperature and humidity sensors detect environmental parameters. The parameters are transmitted to the oneM2M platform through the wireless network, and the growth environment of succulent seedlings and the control of relevant intelligent devices are displayed on the front page.
2. Related work

In China, there are many cities with agriculture as the main economic development, such as Weifang in Shandong Province. But most of them neglect the cultivation of plants due to their busy work, which makes plants dry and difficult to plant. In addition, in the era of the Internet of Things, the concept of intelligent furniture has been deeply rooted in people's hearts, so intelligent plant cultivation system has become a hot topic[1].

The research on environmental control system of greenhouse in China began in the middle of 1980s. The most commonly used control method is single factor control [2]. With the development of science and technology, more research achievements have been made on plant culture based on greenhouse. The IoT technology is also used here. Connect the IoT with photovoltaic greenhouses, Photovoltaic greenhouses are connected to the Internet of Things to obtain relevant data, thus changing their current state [3]. Combined with the IoT cloud, the green plant automatic diagnosis and treatment intelligent agriculture system uses TCS3200 color sensor to recognize the features of leaf viruses, and sends the data back to the Arduino embedded development board. Finally, combined with the cloud technology of the IoT, users can adjust the exhaust system, lighting system and humidification system in the system through the cloud or mobile phone to improve the environment and alleviate plant diseases [4].

The oneM2M standard is currently the most authoritative standard in the field of Internet of Things in the world. On the one hand, it supports the unified management of devices of different application types; On the other hand, it standardizes the interconnection between devices through unified standards. At present, oneM2M is the most authoritative standardization organization of the Internet of Things in the world. It was established in July 2012, mainly by the cooperation of authoritative standards organizations of the information and communication technology industry in 7 countries [5]. In the first stage of ONEM2M standard formulation, intelligent energy, intelligent building, intelligent home, intelligent medical care and other fields have been covered [6].

3. Architecture based on oneM2M

3.1. OM2M system architecture:

- AE, AE is the abbreviation of application entity. Its main function is to realize the application service logic of oneM2M. One oneM2M node can have multiple different AEs, and one AE can also be used on multiple oneM2M nodes. AE-ID can uniquely identify each AE. AE is used in many places in life, such as remote blood pressure monitoring and real-time monitoring of sensor data.

- CSE, CSE is short for public service entity. Its main role is to provide services for oneM2M, such as notification operations, device management, location monitoring, etc. These services can be shared by other entities through Mca, Mcc, and Mcn interfaces.
• NSE, NSE is the abbreviation of the underlying network service entity, and its main function is to provide the underlying network services to the CSE.
• Interface:
  Mca: Used for communication between AE and CSE.
  Mcn: Used for communication between NSE and CSE.
  Mcc: Used for communication between CSE and CSE.
  Mcc': used for communication between CSE and other network basic domains.

3.2. Communication protocol of oneM2M:

![Figure 2. communication protocol](image)

The oneM2M standard supports MQTT, CoAP and HTTP communication protocols. MQTT is a many-to-many protocol in which multiple clients pass messages through a central agent. It decouples producers and consumers by letting the client publish messages and the agent decides message routing and replication. Although MQTT has limited persistence, it is the best group real-time communication bus. CoAP is a one-to-one protocol that transfers status information between Client and Server. Although it supports observing resources, CoAP is most suitable for the state transition model, rather than purely based on events. HTTP is suitable for use on terminals with better performance. It is heavier than some of the above and has relatively higher requirements for equipment, which is not suitable for M2M scenarios. MQTT is based on TCP, which is more reliable than UDP when used as an anti-control device. MQTT is implemented in asynchronous Pub/Sub and can continue without waiting for the other party's confirmation. CoAP must wait for the other party's response to return to the synchronous mode. At the same time, MQTT's QoS and last words characteristics It is very friendly to the application scenarios of the Internet of Things and is very suitable for group communication deployment.

3.3. Design principle:

![Figure 3. system model by OM2M](image)
This system uses OM2M framework to achieve. OM2M framework is an open source framework developed based on oneM2M standard protocol and supported by Eclipse open source. OM2M relies on OSGi technology to modularize oneM2M standard, which makes OM2M have rich extensibility and flexibility. Developers can write OSGi plug-ins to support the OM2M framework according to their own needs. In the case of plant cultivation, OM2M CSE, Node MCU and others register bindings with MQTT Broker. The MQTT Topic is set according to the MQTT binding protocol of oneM2M. Subscribe to the corresponding topic to complete the MQTT communication configuration. According to oneM2M standard JSON string, you can complete the operation of CRUDN.

3.4. Application scenarios:
Applied to the cultivation and breeding of green plants. Improve the survival rate of plant seedlings and reduce manpower.
Sensors, controllers, and applications are used to implement various basic services.

3.4.1. Application structure and function:

![Figure 4: user control model](image)

The system realizes the following functions:
The Node MCU uploads the temperature, humidity, light and other information of the environment where the plants are located to the server, and the user can view the above information after obtaining the permission. At the same time, it can also send instructions to the Node MCU through the Web page to control the operation of the terminal device.

3.4.2. Experimental results:
Based on the above system, taking succulents as an example, the function of cultivating succulents is realized.

![Figure 5: collecting transmission model diagram](image)
Figure 6. Hardware model diagram

Built-in sensor module: temperature and humidity sensor, soil humidity sensor, carbon dioxide sensor, light sensor. The sensor processes the collected data through the Node MCU, packs it into a JSON string, and sends it to the server. The user can view the environmental status of the succulents through the background management page, and can send instructions to the basic hardware through the web page. For example, when the user perceives that the soil moisture of the plant is low, the user can set the watering amount and send the watering instruction. The bottom Node MCU drives the motor to start working, and when the watering threshold set by the user is reached, the motor stops working.

4. Conclusion
Based on the oneM2M standard and the OM2M framework, this paper implements the design of a plant cultivation system, which can complete the real-time monitoring of the relevant factors that affect plant growth and use the Internet of Things system to realize the process of automatically cultivating plants. But there are also some problems that need to be improved in future work.

- The design of this system uses only one MN-CSE for testing and verification. The stability of the system in complex scenarios with multiple MN-CSEs and multiple AEs remains to be verified.
- Each set of hardware needs to change part of the source code in different scenarios, which is complicated in operation and maintenance in large-scale applications. In the future, it is hoped to improve the middleware to support the rapid deployment of hardware.
- OM2M framework uses its own H2 database by default. It may not be able to meet the future high concurrency and high data volume IoT application scenarios.
- This system uses a general Node MCU board. In the next step, we will make further adjustments to the current problems, find more matching hardware devices to improve the flexibility of the system.

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