

Using a Dynamic Domain Name System (DDNS) Technology to Remotely Control a Building Appliances Network

Kun-Wei Lin and Zheng-Han Jiang

Abstract—With the Internet of Things (IoT) architecture matures, the application of IoT is also more and more widely. In this paper, the appliances can be directly control through our design system. Furthermore, our studied system is scalable. Compared with the previous researches, we have solved the problem of required a fixed IP for remote control. We use dynamic domain name system (DDNS) approach and improve the data transfer between node and node to control the appliances of entire building. The appliances can be directly control through our design system. Furthermore, our studied system is scalable. Our designed remote control appliances are used in the suites.

Index Terms—IoT, Raspberry Pi, appliance, dynamic domain name system.

I. INTRODUCTION

With the rapid development of science and technology, the application of Internet of Things(IOT) has become increasingly popular. The concept of Internet of Things is that all items can be transmitted each other through the Internet. At present, some electronic products have been able to communicate with each other through the Internet of Things; the application of Internet of Things not only makes human interact with machines, but also allows machines to interact automatically each other to obtain the corresponding information.

This study will produce a remote control home appliance system that can control the electrical appliances of the entire building at the same time. In the present study, Filibeli et al. proposed a system for daily household appliance management via web control [1], which successfully solved the inconvenience of life. However, such a design required a computer to set up the control system, so cost and structure limit its applicability

In reference [2, 3], embedded systems were used to set up the server. Therefore, the control itself is the server, and it can achieve one to many controls; the operating principle is to use webiopi to set up web pages and control GPIO to output signals to the relay, and then control circuits.

Therefore, each that needs to control the appliance only needs to connect the relay control terminal, so each is possible to develop a remote control system that controls

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multiple appliances by an embedded system. However, such a structure can only be in a floor or area that network signals can reach, and cannot achieve the purpose of controlling the building.

The cable lines of the above control circuit must be connected to the GPIO. If only an embedded system is used, then the lines to set up the entire building floor must be stretched, which will be difficult in the building. When setting up multiple embedded systems, the problem of communication between multiple embedded systems must be overcome. In the reference literature [2, 3], they did not explain the network building, and how to connect back from the external network to the home network. Another important point is that if only private IP of regional networks is used, it is unable to reach from the external network connection. At present, the IP for homes or enterprise networks is mostly floating, and a floating IP will be updated once every period. When updating, due to address change, it will cause the original address setting invalid, resulting in no connection. Therefore, it cannot be used as a remote address. If a fixed IP is used, the cost will be substantially increased, and it is not practical.

We have improved the traditional way of building the control network, and we included the DDNS to solve the problem of network connection. With the progress of the times, the Raspberry Pi has gradually replaced the embedded system because of its small size and powerful function. In this study, we use one Raspberry Pi as the total control. Through the web connection, the domain of DDNS will update the corresponding IP from time to time. Therefore, we only need to connect through the web, which can remotely control the appliance system network. Such setting will allow us to be directly connected to the system without the need for a server.

II. ARCHITECTURE INTRODUCTION.

The whole system is divided into two parts: server system, and circuit control. In the server system, we use the Raspberry Pi as the basis of the server since the Raspberry Pi as the server has the advantage of no occupying space, low cost, and high stability. In circuit control, GPIO of the Raspberry Pi sends signals to the circuit switch to open the relay to achieve control of the function. In the server system, we use the web server of webiopi as a control. The architecture of the server is shown in Fig.1. The webiopi, DDNS updates, web control and transmission controls are

described below.

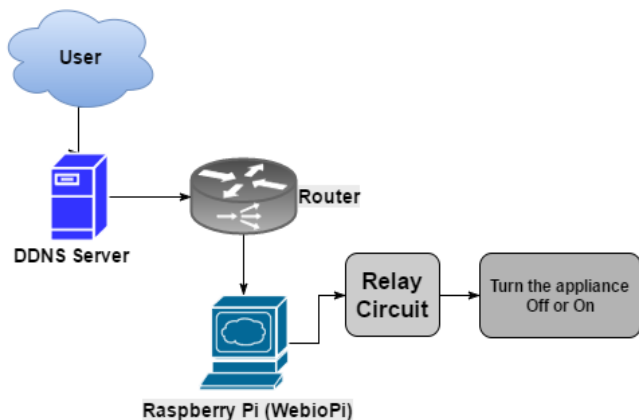


Fig. 1. Server Architecture.

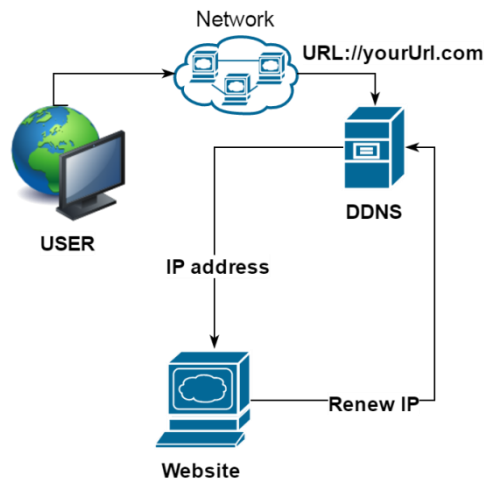


Fig.2 URL to IP address

A. Webiopi

In order to allow users to facilitate the operation, we use the web page to present, and choose the service webiopi written by python as a server service.

You can use the webiopi library to remotely manipulate anything you want to do, such as controlling GPIO, executing script programs, setting up web pages, developing APP, and so on.

B. DNS

DNS (Domain Name System) is a system to allow users to easily remember the URL rather than a string of numbers formed by the network address. DNS will convert the web address into readable text, and this string of text is called Domain Name.

C. DDNS updates

In order to solve the problem of a floating IP, we use the Dynamic Domain Name System (DDNS). The update purpose of DDNS is to check whether the IP is changed every other time. If there is any change, the new IP will be updated. Therefore, the corresponding IP of DDNS will have the correct address, without the connection problem of a floating IP. (The detailed flow is described in Section 4.1)

D. Web Control & Transmission Control

Our customized web interface allows users to understand the operation of the page. Pressing the button on the page will make the corresponding GPIO pin output signals to achieve the effect of controlling household appliances (detailed explanation will be Section 4.7 as well as Section5).

III. METHOD

In setting up the server, in order to allow the network to remotely control, we encountered some obstacles in setting the web page. Most users use a floating IP, but a floating IP is absolutely not feasible to connect to the web page. This section describes the solutions, server setup and control.

A. DDNS

Setting up the server usually requires a fixed IP for users and maintenance managers to easily connect, but most users use a floating IP. A floating IP address will be changed from

time to time to make the user not have a fixed address to be connected. The solution can apply for a fixed IP. But the cost is too expensive. Therefore, we propose to use the DDNS solution. DDNS is dynamic DNS, and can change the URL corresponding IP, as shown in Fig.2. Then we use a script to update the IP, such as algorithm 1. We put a hash value used with the DDNS server authentication hash value, and then every time the script will check whether the IP changes. If there is a change, it will catch a new IP address which will be uploaded to DDNS for updating a new address. Therefore, we only need to be connected to our servers via a URL.

Algorithm 1. Update IP.

```

1 Script_RenewIP(hash_value)
2 begin
3 while time is up do
4 if CheckIP() do
5 new_IP = checkIP().getnew()
6 updateIP(hash_value,new_IP)
7 end
8 end
    
```

B. Raspberry Pi installation

This study used a third generation Raspberry Pi for development. Raspberry Pi is a microcomputer, and its size is about a credit card. When compared with the first and second generations, the third generation possesses high performance, and uses 64-bit quad-core ARM cortex-A53 (1.2 GHz) and 1GB of memory. At the same time, the third generation comes with wireless networks, dual Ethernet network card and wireless Bluetooth communications. The memory card used in this study was 8G, and Raspbian was installed on the system.

C. Web server setting up webiopi

Raspberry Pi itself has an open free software suite that can directly set up web server. First of all, we will download the source of webiopi and install, install the python package at the same time, and finally set the automatic start service, as shown in Fig.3.

The languages that communicates webiopi are JavaScript as well as Python. The account password to login webiopi can be changed according to users' habits; it can be preset by the

F. Network port service

On the circuit, we use a transistor as the open switch. When the Raspberry Pi gives the signal, the transistor switch is turned on, and the current goes through the trigger relay, which is a small power to control a large power switch, as shown in Figs.6 (a) and 6 (b). We can use the relay to control the large voltage flow of a household electrical box as shown in Fig.6 (c). Our designed system can remote control high voltage appliances.

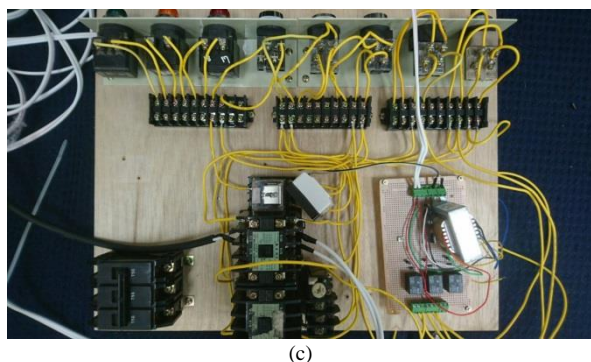
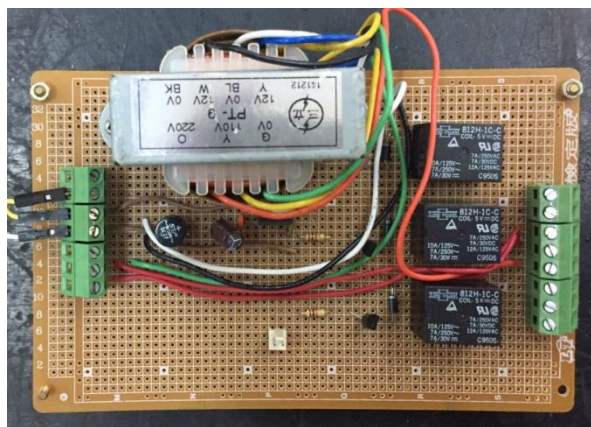
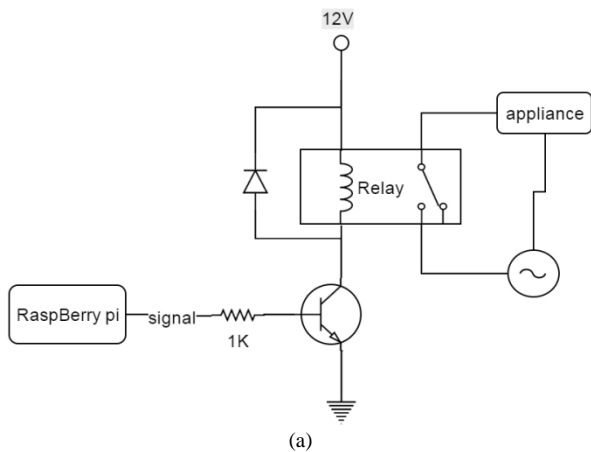


Fig. 3. (a) Relay control circuit, (b) Relay circuit, (c) AC Relay control .

IV. EXPERIMENTAL RESULTS

In this study, a control page on mobile device was designed as shown in Fig.7. We use this control page for the appliance control of the whole building, and for each additional room, the Raspberry Pi will send a room button so that each button press will display the use status corresponding to home appliances, where white color represents no power supply, and red color represents power

supply. We can connect and access the appliance switch anywhere through the Internet without having to go through a specific WiFi or a specific device.

V. CONCLUSIONS

This study uses DDNS to solve the problem that floating IP cannot set up the server. We use webiopi to set up a web server, which is connected to the router through the Domain Name. The signal through port services from the external network is then connected to the Raspberry Pi which was used as the main Control. And the web page is used to control the GPIO signal to trigger the relay switch. By this way our studied system can easily remote control appliances. At the same time the http protocol is used to control the transmission of more Raspberry Pis to achieve the goal of control the whole building. Using this method can make the cost of remote control more inexpensive and make life more convenient.

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