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# Remote Power Control System using the Raspberry Pi

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***Abstract***

*The use of smart devices worldwide has been increasing day by day and its applications based on IoT have been also extended. But the power control system requires complicated control and processing information from the various sensors in practice. One of the best ways to save the power consumption is to manage electrical equipment individually on the Internet. In this paper, remote power control system for managing the power through the relay switch module via Python server was implemented by using Raspberry Pi. The proposed power control system can be used anywhere over the Internet.*

***Keywords:*** *Raspberry Pi, Power Control, IoT, Smart Device, Remote Control*

## 1. INTRODUCTION

In recent years, the technology using smart devices that can be connected by Internet is rapidly spread and related market has also been growing explosively. This technology is often called the Internet of Things (IoT) in many cases. The IoT allows objects to be sensed and controlled remotely across existing network infrastructure [1].

The blackout of 2011 was widespread power outage that occurred throughout South Korea by failing to power forecast. The main reason was that the heat wave was occurred frequently in summer season, so the demand of electricity was very difficult. In order to meet the power needs, the KEPCO (Korea Electric Power Corporation) had decided to go ahead with circulating outage by region in Korea [2]. Electric energy consumption per person has been increasing steadily, and household standby power has reached 11% (306kWh) of total electricity consumption in South Korea. To manage the power growing demand efficiently, home energy management system to control remotely unnecessary power over Internet must be required [3].

In this paper, remote power control system by using Raspberry Pi with single board computer was implemented. The Raspberry Pi [4,5] is a series of credit card–sized single-board computers developed in the UK by the Raspberry Pi Foundation with the intention of promoting the teaching of basic computer science in schools.

The proposed system is able to control the power in a wireless environment using a Raspberry Pi, smart devices, and the relay module. When starting the server from Raspberry Pi over Internet, the remote power

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control system turn the relay switch module on/off through control signal generated by power system controller. But main security issue with wireless networks need to be considered because they intentionally propagate data over an area that may exceed the limits of the area the organization physically controls. To avoid this problem, it can be solved that the user obtains the network access code, such as authentication using ID and password, necessary to join the network as shown in Figure 1.

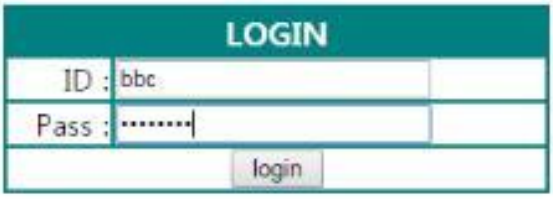


**Figure 1. Log on using Authentication**

## 2. PROTOTYPE IMPLEMENTATION

Electrical devices such as TV, Audio, Washing Machine, and so on are usually connected to the power outlet to receive power. However, unnecessary power consumption that is called "standby power" has been occurred from the electrical equipment which is not working and just connected to the power outlet. To solve the problem, various commercial products such as multi tab with automatic standby power blocking device are available.

But existing products requires complicated control and processing information from the various sensors in practice. One of the best ways to save the power consumption is to manage electrical equipment individually on network environment as shown in Figure 2.

The proposed system based on wireless control using Raspberry Pi and Smartphone is shown in Figure 3. The device is powered by a 5V micro USB, connected to power supply for proving the maximum power, to drive Raspberry Pi 2 and relay module-8. Also 5V power is connected to switch port number from 1 to 5 in Relay module-8. GPIO pins of Raspberry Pi are connected to each pins of Relay module to control the power of individual multi tab, where individual multi tab is to emulate electrical equipment in home.


**Figure 2. Overview of Individual Power Control in Home**

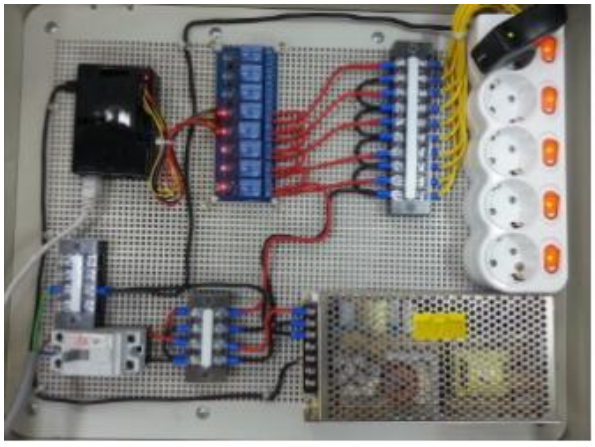

**Figure 3. Power Control System using Raspberry pi 1 Model B+**

## 3. EXPERIMENTAL RESULT

In order to drive power control system, Raspbian OS which has Python, Scratch, Sonic Pi, Java, Mathematica and more was installed to Raspberry Pi, and then Apach server and MySQL was set up to exchange control data [4-6]. Control software to manage the power was programmed with Python language. To access power control system, the user has to authenticate Log on page with HTML. After authentication using ID and password, the power control, that should be turn on/off GPIO pins connected with Relay module, can be managed through control page as shown in Figure 4.

After booting Python server of Raspberry Pi, if ON/OFF button in control page of smartphone then status information of corresponding signal on Python server was dumped as shown in Figure 5. In control page in Figure 4, the power of multi tab can be managed by selecting each ON/OFF buttons. By using the proposed power control system and smartphone, the power of home appliances can be controlled anywhere and anytime when people go out.

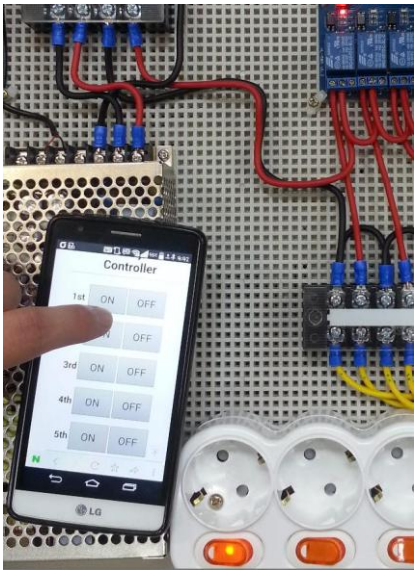


**Figure 4. Individual Power Control of Home Appliances where Multi tab should be replaced to be Individual Electrical Equipment in Home**

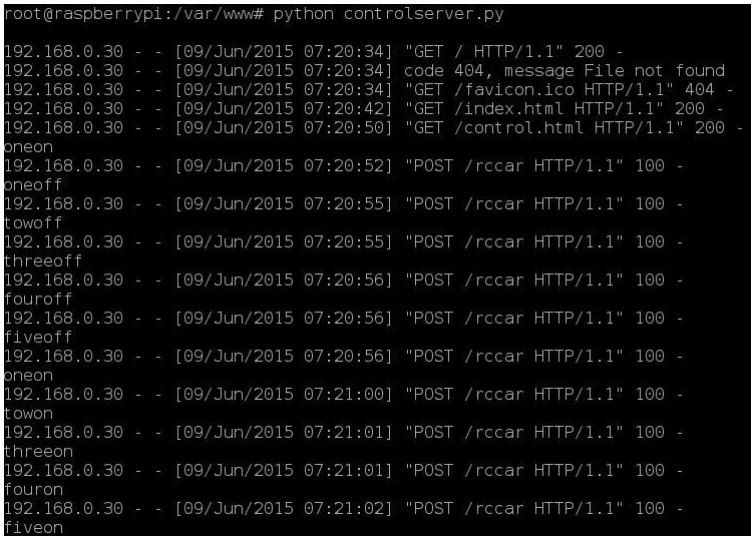


**Figure 5. Dumped Signal Information on Python Server**

## 4. CONCLUSION AND FUTURE WORK

To reduce over-consumption due to the standby power in home appliances, remote power control system based on Raspberry Pi was implemented. Applying the power system, it can be controlled from outside using smartphone while forgetting to turn off the power to the appliances and it is also possible to ensure an electrical safety. However robust security plan should be introduced, although user authentication scheme for server security to avoid security issues was applied.

## ACKNOWLDEGEMENT

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