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iPhone Application
for Controlling Wireless Access Point

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Abstract

Since internet has become essential part of people daily life, the requirements for accessing internet in both public and residential area are growing magnificently.Then the new issue about how to share and manager the internet environment in both public and residential area become important to the users. This project will implement a prototype iPhone Operation System (IOS) application as service manager client to work with improved existing Wifi hot-spot system which is provided by Raspberry Pi (RPI) and remote central management server.

The main idea about this project is to make a system which can provide internet access allocation and internet filtering controls in wireless network. This project is based on previous student master project, that means this project will use same device and resources which used in that master project. To set up existing access control system made by previous master project, most of the references are taken from the master report[Coo13b] written by Torgeir Pedersen Cook.

This report will include the improved internet access control system and IOS administrator application. The improved access control system now will have the function to block the access request device to connect into wireless network for blocking client user purpose. Moreover, the central management server will have better security login mechanism and sending E-mail notification mechanism.The application contains basic administrate access control function like approve access request and block access request from the client user. And also it will have real-time updating access request list and some security communication mechanism.

This prototype has been tested on test RPI device and test wireless network environment.

This report will also discuss the usability of this prototype in the commercial market and better improvement on the basic working mechanism of the access control system.

Acknowledgements

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List of Acronyms

ADT Android Development Tools.

AP Access Point.

DHCP Dynamic Host Configuration Protocol.

DNS Domain Name System.

EAP Extensible Authentication Protocol.

GB Gigabyte.

HTTP Hypertext Transfer Protocol.

IDE Integrated Development Environment.

IEEE Institute of Electrical and Electronics Engineers.

IOS iPhone Operation System.

IP Internet Protocol.

ITEM Telematics.

MAC Media Access Control.

MAC OS Macintosh Operating System.

NTNU Norwegian University of Science and Technology.

RADIUS Remote Authentication Dial In User Service.

RPI Raspberry Pi.

SD Secure Digital.

SDK Software Development Kit.

USB Universal Serial Bus.

WPA Wi-Fi Protected Access.

WPA2 Wi-Fi Protected Access 2.

Chapter 1
Introduction

1.1 Motivation

Based on existing access control system, it is quite promising idea about making normal user have control of the residential area internet access control by using smart filtering, informing and time management. Since the smart phone with the mobile internet access functionality released, more and more sociology research, for instance the paper form Jim McGuigan[McG05], show that there are many weakness of over using mobile phone and internet. The idea of this project is to meet the need of the people who would like to control the daily use of the internet and manager other people access right to some specific wireless network.

Nowadays people are using smart phone to do as much task as they can, because smart phone is easy to carry with and smart phone is the only necessary access people need to have the tons of internet information. Then the requirement of using smart phone to control the existing daily life system such as wireless router, switch and other electronic devices are growing rapidly. This prototype project is to fill the missing part of the previous project to connect the access control system to IOS devices. There are static article[Pro13a] shows that Android has 81.0 percent smartphone share in the third quarter of 2013 and IOS has 12.9 percent, these two mobile operating system shared most mobile operating system in the world. This project will focus on the IOS application to work with the improved access control system. It will make the whole system become more user friendly for normal user to choose different mobile operating system to administrate the system.

1.2 Related Work

There are many security software can do internet control in the market. Such as Norton Family application[Fam13], K9 web Protection[Pro13b], OpenDNS[Sol13] and etc. Most of them can provide block web sites, time restrictions, easy log reports of internet activity and etc. But these kind of software need to install in every access

Figure 1.1: Kickstarter Project: Meet Circle

device in the network. And also it could be uninstalled and broken by accident. They are more like voluntarily joining the internet control policy, which is used greatly on parent and children case but no more other normal cases.

There is a kickstarter[Cir13a] project which has the similar idea as this prototype project. The product name is 'Circle'[Cir13b].Circle is a device1.1, managed by an IOS app, that enables user to choose how you and your family spend time online by using advanced filtering, time management systems and informing to answer the where,why,and how of your network's internet activity. Although it is just a start-up project, its concept and prototype device are quite promising in the promote video on the kickstarter. The main and unique functionalities Circle has are time management capabilities, device and application notifications, safe,pause and bedtime modes and cost effective for the system.

The prototype of this report is using RPI as the same function as Circle's wireless router. And this prototype system has server side back-end to store client and administrator user database. There are android and IOS applications both work with the internet control system in this project.

At application side, the prototype application of this report will have the same administrator function to approve and block the client internet access request through http request.

For the notification function of the system, the project of this report has the similar idea with another kickstarter project 'NINJA SPHERE'[oYE13]. The idea of NINJA SPHERE is to make the next generation control of your environment with accurate in-home location data and a gesture control interface. Although the project of this report will not cover the advanced way to control the environment of the residential area only the internet access control of the residential area, the idea is

still the same to use mobile application to communicate with the other device and even get notification from other device in the same wireless network area.

The notification of the client request in this project will be sent as notification E-mail. It makes the administrator get updated request information from the internet access control system.

1.3   Scope

The first part of this project will be using the RPI device and the code script from previous student master project report[Coo13b] and previous student Github repository[Coo13a] to set up the internet access control system working.Because the RPI device and Secure Digital (SD) card got from the previous student are without any code and configuration, they should be configured with the reference of previous student master project report.

The second part of this project will be setting up the central management server on the test domain 'apc.item.ntnu.no'(129.241.200.170) from Telematics (ITEM) department of Norwegian University of Science and Technology (NTNU). The work of this report will cover some security concern improvement and some new notification mechanism implement on the remote central management server.And the database structure of the system stored on the remote server would be changed according to the new functionality of the improved internet access control system.

The third part of this project will be implementation of the IOS application intended for end-user to manage and control clients' internet access. The application would be implemented under the IOS 7 Software Development Kit (SDK) and Xcode[Xco13] 5.0 Integrated Development Environment (IDE) on the Macintosh Operating System (MAC OS) 10.8.5 working environment. Since there will be some changes for the central management server, then the android application need to be modified to work with the new back-end server. The changes will be made under Android Development Tools (ADT)[Plu13] 22.3.0 IDE. These two platform application will be tested against central management server and RPI device to make sure all the basic administrator function working well.

The fourth part of this project will be research about how to make the current internet control system more safe and how to implement more advanced internet control function in the current internet control system. The research would be based on articles and some demo testing script using in the current working internet control system.

1.4   Report Structure

In the System Description chapter, it will cover the general information about the previous internet access control system and the improvement form this report project to the current system. In this chapter, some background knowledge of the previous master project[Coo13b] would be mentioned as well.

In the RPI Setting chapter,the main content about the progress to set up RPI internet access control will be presented. Some related modification for previous master project would be mentioned in the chapter. And some background research would be including in this chapter to analyze the performance of the current internet access control system

In the Central Management Server Improvement chapter would have some detail improved code snippet to be discussed why the previous prototype project need to be improved in this way. And it will show database structure changes on the back-end server as well.

In the Mobile Application Development chapter, it will present the basic working process of the application development for this prototype project and some test case to work with the other system components in this internet access control system. The main content of this chapter would be about IOS application development, but also it will have some modification explanation for android application.

In the System Testing chapter, it will show the feedback and analysis from the testing of the prototype project. The analysis will have some future improvement suggestion for later work since there are not enough time to implement the solution to some testing cases.

In the Future Work chapter, it will present some better solution for current project to do the internet access control which can not be implement within such short period of this project working time. And there will some exploring point for the project based on the research of the technical articles.

Chapter 2

System Description

2.1 Existing Internet Access Control System

This project is based on the existing internet access control system. The existing system provides a manged service for the administrator of the system. The Fgiure 2.1 shows the architecture of the existing system. In the system the manageable residential access point is RPI which has the function as wireless access point and router. The setting progress and changes of this report project will be covered in the chapter 3. The management server in this architecture is host on the remote server to communicate with the other component in the system. It stores system database and provides Hypertext Transfer Protocol (HTTP) communication interfaces. The mobile management application and web management application have the same function in the system which is allowed administrator to manage and control the whole system in more mobile and flexible way. The applications for mobile platform covers IOS and android mobile operating system, since they are main two mobile operating system in the current smart phone shared market.Due to the time limit of his project, the web application development will not be covered in this report although it is easier to make and the working process is the same as other tow platform application. The main function of the mobile applications is to manage the client user internet access request. The more detail about this will be covered in the chapter 5.

2.2 Improvement of Existing System

According to the master project report [Coo13b], there are several function requirements mentioned in that report. In this project, the improvement functions of the system shows in the Table

Table 2.1: : Improvement Functions for System

| No.	Title	Improvement Function	Importance
1	Block Internet Access	The residential access point can block clients internet access base on MAC and forbid the Internet Protocol (IP) address request	High
2	Bug Fixed for static IP lease	Bug found in the report with wrong script format in static IP lease for residential access point	High
3	Bug Fixed for Missing script	Bug found in the report without essential script file	High
4	Broken SD card changed	Changed broken SD card in the project	High
5	Security Log on service	Implement security log on mechanism for mobile log on request	High
6	Complete Authenticate Log on service	Complete implementation of authenticate log on by user-name and password	High
7	Separate working protocol	Separate client request protocol and mobile management application working protocol on central management server	Medium
8	Set up Database Management Tool	Set up phpmyadmin[Wp13] to manage database on the central management server	High
9	E-mail Notification Mechanism	Implement E-mail notification mechanism on central management server to notify the client user internet access request	High
10	Security Log on	Implement security log on function on both android and IOS mobile application	High
11	Approve and Block Internet access	IOS Mobile Application can approve and block the client internet access request	High
12	Real-time update	IOS Mobile Application can real-time update all the client internet access request	Medium
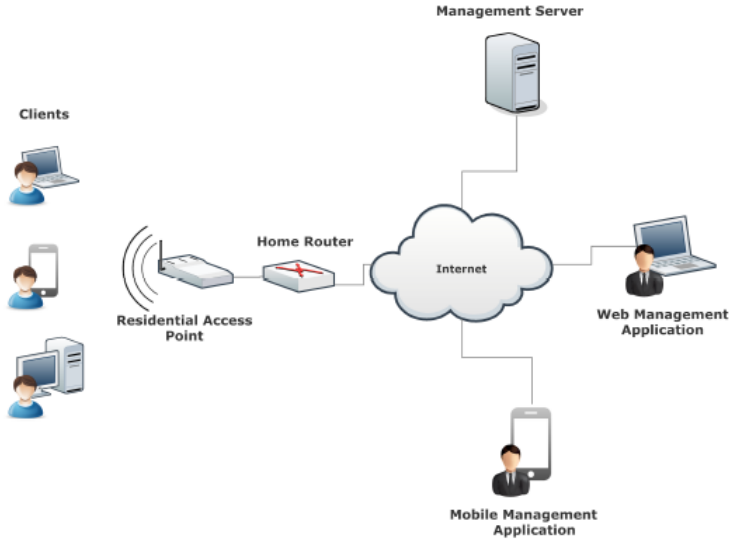
Figure 2.1: Existing System Architecture

2.3   Analysis of System

The system is based on client-server model [mod13], which is a distributed application structure in computing that partitions tasks or workloads between the providers of a resource or service, called servers, and service requesters, called clients. Since in the internet access system, the request client users connect with the residential access point (in this project will be RPI), so it is better for the service to provide client-server model communication between different client users and residential access point.

Moreover, there will be different residential access point from different residential areas to connect with the same service provider central management server since the central management server will provide the server back-end service and store the database with information for administrator authentication , different residential Media Access Control (MAC) address and other necessary service data. The main database of the system should be able to be managed and modified by the administrators. Then the client-server model also would be quite fit into this scenario.

According to the communication between mobile application clients and central management server, the client-server model of this architecture is better for central management server to response of the HTTP request and manage the whole service

of the system.

More detail about the different component application architecture would be covered in the individual chapter 3, chapter 4 and chapter 5.

Because there is no running system from previous student master project when this project begin, the performance between previous system and current improvement system would not be compared during this report. However, different improvement of the internet access system would be discussed in the later chapters. And all the improvement function would be only based on the master project report[Coo13b].

Chapter 3

Raspberry Pi Setting

3.1 About Raspberry Pi

The RPI is a credit-card-sized single-board computer developed in the UK by the Raspberry Pi Foundation with the intention of promoting the teaching of basic computer science in the schools. [Pi13] The RPI has a Broadcom BCM2835 system on a chip, which includes an ARM1176JZF-S 700 MHz processor (The firmware includes a number of "Turbo" modes so that the user can attempt overclocking, up to 1 GHz, without affecting the warranty), VideoCore IV GPU, and was originally shipped with 256 megabytes of RAM, later upgrade to 512 MB. It does not include a built-in hard disk or solid-state drive, but uses an SD card for booting and long-term storage. The Foundation's goal was to offer two versions.

3.1.1 RPI Hardware for Project

In this project, one Kingston 8 Gigabyte (GB) SD card is used instead of previous Samsung 16 GB SD card in the master project[Coo13b] because the Samsung 16 GB SD card used in the previous project is quite unstable since its root file system has been broken by the voltage changes of the Universal Serial Bus (USB) hub on the RPI during the development of this report project.

In this project, it will use model B as the residential access point because the model B is more powerful on the hardware than the model A, and it has two built in integrated 3-port USB hub. Since the residential access point need provide the Wifi hot-spot function for other client user to connect to, and the normal RPI is not equited with on-board Wifi block component, a compatible D-link DWL-G122 would be used with RPI by the USB connecting.
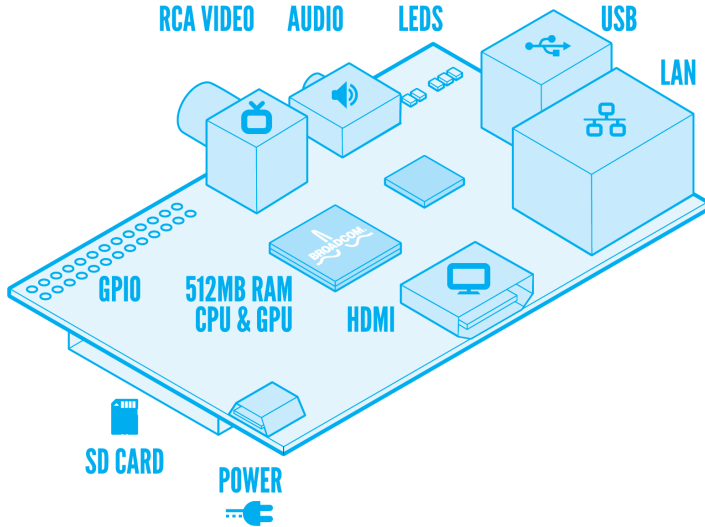
RASPBERRY PI MODEL B

Figure 3.1: Raspberry Pi used as Residential access point

3.1.2   RPI Operation System

The Raspberry Pi Foundation provides Debian and Arch Linux ARM distributions as RPI operating system.Tools are available for Python as the main programming language on the RPI, with support for BBC BASIC (via the RISC OS image or the "Brandy Basic" clone for Linux),C and Perl. In this project the recommended operating system, Raspbian wheezy[Ras13] will be used as RPI operating system. Raspbian is a free operating system based on Debian optimized for the Raspberry Pi hardware. An operating system is the set of basic programs and utilities that make Raspberry Pi run. However, Raspbian provides more than a pure OS: it comes with over 35,000 packages, pre-compiled software bundled in a nice format for easy installation on Raspberry Pi. For this prototype project, this kind of beginner operating system is best choice.

3.2 Project Using Applications on Raspberry Pi

3.2.1 hostapd

Most using package to provide Wifi hot-spot function on RPI is hostapd[hL13] package. hostapd is an Institute of Electrical and Electronics Engineers (IEEE) 802.11 Access Point (AP) and IEEE 802.1X/Wi-Fi Protected Access (WPA)/Wi-Fi Protected Access 2 (WPA2)/Extensible Authentication Protocol (EAP)/Remote Authentication Dial In User Service (RADIUS) Authenticator. The advantages of using hostapd are that it is compatible well with the RPI and it is easy to manually modified by script configuration file. The set up configuration file shows in Code Snippet3.1.

Algorithm 3.1 Code Snippet for hostapd configuration file

```
interface=wlan0
driver=nl80211
ctrl_interface=/var/run/hostapd
ctrl_interface_group=0
ssid=raspberry
hw_mode=g
channel=8
wpa=0
beacon_int=100
auth_algs=1
wmm_enabled=1
```

3.2.2 Dnsmasq

For dynamically allocating IP address for connected clients with RPI, the protocol, Dynamic Host Configuration Protocol (DHCP) [Pro13c] is using in this project. DHCP is a standardized networking protocol used on IP addresses and other information that is needed for internet communication.DHCP allows computers and other devices to receive an IP address automatically from a central DHCP server(RPI in this project), reducing the need for a network administrator or a user from having to configure these settings manually. This working process is fit the requirement of prototype project because client users need have a IP address to have the access to post internet access request to the central server then wait for the response of it. And the recommended networking protocol using in this case from the RPI community is DHCP.

In this project, on RPI device, the application named dnsmasq [Dns13] will be used to provide Domain Name System (DNS) forwarder and DHCP server. For this

prototype project, dnsmasq is a lightweight, easy to configure DNS forwarder and DHCP server. It is designed to provide DNS and, optionally, DHCP, to a small network, like the residential area wireless network in this report case.

Algorithm 3.2 Code Snippet for dnsmasq configuration

```
interface=wlan0

dhcp-range=unauth,10.0.0.65,10.0.0.94,2m
dhcp-option-force=unauth,1,255.255.255.224
dhcp-option-force=unauth,6,129.241.200.170,129.241.200.170

dhcp-range=auth,10.0.0.1,static,2m
dhcp-range=auth,10.0.0.2,10.0.0.63,2h
dhcp-option-force=auth,1,255.255.255.192
dhcp-option-force=auth,6,8.8.8.8,8.8.4.4

dhcp-hostsfile=/etc/dnsmasq.hosts
```

The configuration file for dnsmasq is shown in Code Snippet 3.2. For this project, we set unauthenticated IP address in the range from 10.0.0.65 to 10.0.0.94, the the lease available time is two minutes. The other hand, the authenticated IP address are in the range from 10.0.0.2 to 10.0.0.62. And for unauthenticated clients, the DNS server would be 129.241.200.170 which is central management server to redirect network traffic for each unauthenticated IP address. For authenticated clients, the DNS server would be the Google Open DNS server to reduce the complexity of the RPI residential access point. Moreover, we set the hosts file to '/etc/dnsmasq.hosts'. this file will store the static lease script. The example script in dnsmasq.hosts would be like Code Snippet 3.3, it includes IP address leased by the client user , MAC address from the client user device and the IP lease available time. The dnsmasq hosts file would be modified when there is any changes from the central management server updating the client user authorization.

Algorithm 3.3 Code Snippet for dnsmasq hosts file

```
e4:ce:8f:03:7f:e0,10.0.0.6,2h
```

3.2.3 Iptables

Chapter 4

Central Management Server Improvement

Chapter 5
Mobile Application Development

Chapter 6

System Testing

Chapter 7
Future Work

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