ENERGY EFFICIENT AND LOW-COST WEB SERVER

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This report is submitted in partial fulfillment of the requirements for the
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SUPERVISOR: ____________________________________ Date: ____________
(DR. NORHARYATI BINTI HARUM)

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ABSTRACT

The growth of traffic on the World Wide Web makes performances a critical issue for web servers. If the server cannot adequately handle the request traffic, the server will fail to satisfy some requests and result in unacceptably slow responses for other requests. This paper analyzes the performances of web server using a Raspberry Pi which is a small computer that uses an ARM 11 processor running at 700MHz with 512MB RAM. The fully featured Linux operating system comes with lots of software, including the Apache web server which is used to host some of the world's biggest web sites. This project focus on how web server works, how to set up and configure a web server, and analyze and study the differences web server performance of high CPU loads and Raspberry-Pi. From this research, I expect best result on how a web server will run on low powered hardware than high CPU loads and result on differences between Text Transactions speed, PNG Transfers, Large JPG Transfers, Availability and how many concurrent users we were actually able to achieve in both web server.

ABSTRAK

Pertumbuhan trafik di web di seluruh dunia membuat isu kritikal untuk pelayan web. Jika pelayan tidak boleh secukupnya mengendalikan trafik permintaan itu, pelayan akan gagal memenuhi beberapa permintaan dan tindak balas yang tidak boleh diterima lambat untuk permintaan lain. Kertas ini menganalisis prestasi pelayan web menggunakan Raspberry Pi yang merupakan komputer kecil yang menggunakan pemproses ARM 11 berjalan pada 700MHz dengan 512MB RAM. Yang diketengahkan sepenuhnya sistem operasi Linux datang dengan banyak perisian, termasuk pelayan Web Apache yang digunakan untuk menjadi tuan rumah beberapa laman web yang paling besar di dunia. Fokus projek bagaimana pelayan web berfungsi, bagaimana untuk menubuhkan dan mengkonfigurasi pelayan web, dan menganalisis dan mengkaji prestasi pelayan web perbezaan beban CPU yang tinggi dan Raspberry-Pi. Dari kajian ini, saya mengharapkan hasil yang terbaik bagaimana pelayan web akan dijalankan pada perkakasan berkuasa rendah daripada beban CPU yang tinggi dan menyebabkan ke atas perbezaan antara kelajuan Transaksi Teks, Pemindahan PNG, JPG Pemindahan besar, Ketersediaan dan berapa ramai pengguna serentak kami benar-benar dapat mencapai dalam kedua-dua pelayan web.

TABLE OF CONTENTS

LIST OF TABLE

LIST OF FIGURE

CHAPTER I

INTRODUCTION

1.1 Project Background

This project based on the worthiness and benefits of using micro-computing boards which is Raspberry Pi to serve Web content. The goal of project is identify between cost and performance in such system. According to [1], Raspberry Pi an independent, stand-alone platform and best portable hardware over the past couple of years Raspberry-Pi is gaining popularity especially in United Kingdom as affordable micro-computing boards for learning.

“Raspberry Pi” Raspberry 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 [2]. The simplicity that could be potentially is achieved by using portable devices instead of using high-load and heavy server.

In [3], web server is defined as “Device that connected to network which manages application also network source”. Server functioning as provides services that respond to request across networking using hardware and software. It is new thing which Raspberry Pi is setting up as a web server administration. Its energy efficiency than a PC, low cost and portable which you can bring easily.

To explore more about the feasibility of Raspberry Pi, we evaluate the performance of an Apache Web server implemented on ARM-based Raspberry Pi and compare it to the standard x86 server. We focus on the tradeoff between send request time and response time of these servers. We also show that a Raspberry Pi is categorized as a server at high arrival rates. We consider the feasibility of using portable and low-power servers is multi-server configurations which achieved a desired minimum response time.

1.2 Problem Statement

The research problem is found in this project. Which the problem statement can related with the objective.

Table 1.0: Summary of Problem Statement

PS	Problem Statement
1	The conventional Web server implemented in standard server causing heat and high load issues and it’s costly.

1.3 Project Question

Project Question (PQ1, PQ2 and PQ3) are found based on Problem Statement (PS1). Project question (PS) is built to study the project problem as described in Table 1.3.

Table 1.1: Summary of Project Question

PS	PQ	Project Question
1	1	How the Raspberry Pi server support Web server in loading Web browser through a network?
	2	How Raspberry Pi also can have network connection in LAN and configuring web server which can help in solving the weakness the standard x86 servers?
	3	How to prove the Raspberry Pi performances in server to fulfill the requirement that need in Web server?

1.4 Project Objective

There are three project objective identified which are listed as below and Table 1.4 summarize the objective that can be achieve at the end of this project.

P0 1: To identify how Raspberry Pi support Web server works in loading a file through network traffic.

The purpose of this research is to identify how Raspberry Pi supports Web server works in loading a file through network traffic. So it can help us to determine how it processing to load the request and response time for serving static Web content for small and large websites.

P0 2: To study how to set up network connection and configure web server in Raspberry Pi that can overcome the weakness of the standard x86 server.

The purpose of this project is to analyze the features of Raspberry Pi that are more efficient than standard x86 server in serving more compute-intensive dynamic web content and portable web server to host large websites.

P0 3: To analyze the performances of Raspberry Pi workload in actively serving Web server to achieve a minimum response time.

The analyses of this project is to determine the performance of Raspberry Pi in serving Web server and compared to standard x86 server to evaluate the desired performance level for both server and to show that Raspberry Pi is portable than standard server.

Table 1.2: Summary of Project Objective

PS	PQ	Project Objective
1	1	To identify and understand how Raspberry Pi support Web server works in loading a file through network traffic
	2	To study how to set up network connection and configure web server in Raspberry Pi to overcome the weakness of the standard x86 server
	3	To analyze and study the performances of Raspberry Pi

		workload in actively serving Web server to achieve a minimum response time and compare the results with standard server

1.5 Project Scope

The scope of this research will focus on some issues as stated below:

1. This project is focused on request and response time of Web content in Apache Web server also other features and performance of Raspberry Pi and standard x86 server.

2. For this research, a workstation is required for setting up and configuring both Web servers especially in performance in sending data based on workload of response time.

3. This project uses software and hardware to produce the resulting which we can make a comparison between Raspberry Pi and standard x86 server.

1.6 Project Significance

Raspberry Pi is new technologies that have attracted researchers nowadays, because it is expected to achieve highest possible performances of multi-core Web servers for both static and dynamic content. Apache web server is one of the biggest web sites because it is presented in Linux operating system and it is a perfect small server in processing various types of throughput using persistent connections.

1.7 Conclusion

This chapter described background of project, the scope and issue before the clearly until recently project began in this project. The project question of this project is how the Raspberry Pi server support web server for static content web browser by loading a file through a network?, how Raspberry Pi also can have network connection in LAN and configuring web server which can help in solving the weakness the standard x86 servers? And how to prove the Raspberry Pi performances in server to fulfill the requirement that need in Web server? While the objectives of this project is to identify how Raspberry Pi support Web server works in loading a file through network traffic, to study how to set up network connection and configure web server in Raspberry Pi to overcome the weakness of the standard x86 server and to analyze the performances of Raspberry Pi workload in actively serving Web server to achieve a minimum response time and compare the results with standard server. This analysis can show all lead to delay processing, throughput and data with Apache web server and *ab* tools. In next chapter, the section will describe the study of literature.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

This chapter hash out about literature material information published by project. Literature review is a collecting related data, analyse processes, analysis of current problem and make a conclusion based on situation. The process involves for literature review are planning, reading, researching and analysing all the resources. The fact and finding that is obtained through journal, book and website will be described in this chapter. In this project, there are three paper that be selected which is "*An Analysis of Web Server Performance*" by Arun Iyengar, Ed MacNair and Thao Nguyen. Second, "*Greening Web Server: A Case for Ultra Low-power Web Server*" by Benoy Varghese, Niklas Carlsson, Guillaume Jourjon, Anirban Mahanti and Prashant Shenoy and last by Jun Li, Menghan Lu in his article "*The Performance Optimization and Modeling Analysis based on the Apache Web Server*". A literature review can be done in a simple summarization of the resources, but it usually combination of summary and synthesis, comparison and critique. A summary and synthesis based on the key findings relevant to this project. A comparison and critique is evaluates the advantages and disadvantages to this project.

2.2 Related Work/Previous work

a) Raspberry Pi

Raspberry Pi is a cheap, small sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is tool capable of allowing people of all ages to explore computing, and to learn how to program in languages like Scratch and Python. It's capable of do everything you would expect a desktop computer to do, from browsing the internet and playing high-definition video, to create spreadsheets, word-processing, and playing games. Raspberry Pi is contained on a single circuit board and has ports for: HDMI, USB 2.0, Composite video, analog audio, Power, Internet, and SD Card. Computers running fully on open-source software and provide students the ability to mix and match the software specified to their wish.

b) Web Server

Web servers are computers that deliver (*serves up*) Web pages. Every Web server has an IP address and possibly a domain name. For example, if enter the URL *http://www.pcwebopedia.com/index.html* in your browser, this sends a request to the Web server whose domain name is *pcwebopedia.com*. The server then fetches the page named *index.html* and sends it to your browser.

It is a program that uses client/server model and the World Wide Web's Hypertext Transfer Protocol (HTTP), working files that make up Web pages to Web users (which contains the HTTP clients computers that submit their requests). Every computer on the Internet that contains a Web site must have a Web server program. Considerations in choosing a

Web server include how well it works with the operating system and other servers, the ability to control server program, security features, and publication, search engine, and tools of building websites that can come with it characteristics, and publishing, search engine, and site building tools that may come with it.

c) Previous Work

Based on the **Arun Iyengar, Ed MacNair and Thao Nguyen** in their project "*An Analysis of Web Server Performance*" Sites with high number of request will create issue in performance of Web server. These article studies performances of Web Servers under high CPU loads and how they study simulation by analyze web logs and performance data from real sites [4]. Performance is increasingly influenced by the percentage of requests for dynamic HTML pages. So, main purposed for this paper is performance of Web servers using simulations incorporating input parameters from actual systems, dynamic page be kept as low to optimize performance. API's techniques use to invoking server program to keeping generating dynamic pages as required low. It focuses on situations where CPU processing power in the limiting resource. They simulated a heavily loaded Web server and determined the distribution of request latencies for different sets of parameters.