E-Canteen For The Smart Campus Application

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Abstract. Nowadays in 4.0 industrial and digital economic era, all of the manual serving should be changed by the serving service which use a technology as the helping tools and applications to support the smart canteen in solving the problem of serving food and the queue for paying. Therefore, e-canteen web system with the Raspberry Pi as the sever is created, which can ordering directly through the table of customer without waiting for the waiter to bring the menu, and even for payment as well because the system is compactly designed to make it easier for cashier, waiters and even for chef in the kitchen in coordinating each other.
The test is conducted by the support of the Apache JMeter software to do the testing of server ability in handling many clients based on the response time from server. The results show that Raspberry Pi 3 Model B with Ram 1 GB capacity able to handle numbers of threads (users) more than 150 users at the same time with respons time value around 8 ms - 17.6 ms and throughput value around 132.23 request/sec. In parameter QoS testing, when using WiFi network in Raspberry and *Wireless Network Adapter* ARGtek ARG-1209 type, it is obtained that the index value is 3 with 87,5% percentage which means the QoS value in web access analysis when using the Raspberry WiFi network as well as the Wireless Network Adapter is in the good category.

Keywords: e-Canteen, Raspberry Pi, Apache JMeter, WiFi network, Wireless Network Adapter, Queue Solution.

1 Introduction

The development of technology always showing the rapid improvement in information and communication technology. Especially in this modern world, everybody wants easiness and rapidity to fulfill their needs. Efficiency and effictiveness are the most influential factors to create it. One of the way to create the efficiency and effictiveness is by using the technology system which can make each works become more effective and efficient.

In Indonesia, the application of technology system which can make each works become more effective ad efficient is still lack in order of the technology development. For instance, in cullinary industry such as canteen. Canteen is a familier thing in office and school environment.

According to Azwar, Sapri 2012 [1]: Canteen of Hasanuddin University is a place where the students can spend their time to eat, drink, or just for taking a rest. But the payment transaction still in manual process and using cash for the payment. It caused a queuing problem. Therefore, a Smart Card is designed as the tools of transaction in canteen. By using the Smart Card as the payment tools, the queue in cashier could be solved [2]. But the queue for ordering food still unsolved. The ordering method of food and drink still using the manual system which take much time.

Now to fulfill the needs of the customer, mostly the canteen let the customer to make a line in front of the cashier or waiting for the waiter to come and give the menu, then make an order for food. After they finish to eat, the customer go to the cashier to pay the bill, then it will make a line again. The manual ordering also tend to make a mistake on misspell of the menu which had been ordered by the customer. The service, ordering and payment method of this system show how ineffective and inefficient it is. Therefore it needs a system which could be make a direct ordering through customer's table without waiting for the waiter to give them menu list, or making a line in front of the cashier either to order or pay the bill.

According to Vinayak Ashok Bharadi,Ph.D. et al. 2013 [3] : E-menu provides the information about the menu items with interactive pictures. Sometimes there are many confusions which happened in the kitchen about the

menu that had been written by the waiter. The using of tablet will minimize the ordering mistakes, and make a faster service as well.

Based on the description above, there will be an effective and efficient system which is designed for the canteen service by using WEB that had been installed in tablet as the ordering tools. The pictures of the food and drink with the prices from canteen will appear in the tablet. The customer could choose the menu that they want by using the tablet which is available in each tables. After finish the ordering, the kitchen will receive a message about the food and drink that had been ordered by the customer, then the chef in the kitchen will serves it. The cashier will also receive the order list and the amount of customer's bill, therefore the customer will just pay the bill directly without check their order list. To connect the customer to the cashier and the kitchen, it is used Raspberry Pi as the server. Therefore, the authors consider to create an ***"E-Canteen for the Smart Campus Application"*** as the solution to solve the long queue lines problem in ordering and payment process.

2 Theoretical Background

2.1 Raspberry Pi

Raspberry Pi is a single-board computer in a credit card size with the operation system which is generally in Linux base that in its development already capable to run the operation system in Windows IoT base. The development of Raspberry Pi was started since 2006 by a non-profit institute of Raspberry Pi Foundation, which consist of volunteer and academician of technology in England [4].

Raspberry Pi 3 has a system of Broadcom BCM2837 A 1.2GHz 64-bit quad-core ARMv9 CPU,802. 11n Wireless LAN, Bluetooth 4.1, Bluetooth Low Energy (BLE). Same as the Raspberry Pi 2, the Raspberry Pi 3 also has 1GB RAM, 4 USB ports, 40 GPIO pins, Full HDMI port, Ethernet port, combination of 3.5mm audio jack and composite video, Camera interface (CSI), Display interface (DSI), Micro SD card slot, VideoCore IV 3D graphics core. It is not included the hard disk built in or solid state drive, but using the SD card for booting and persistent storage. The institution provides the distribution of Debian and Arch Linux ARM to be downloaded. Phyton language as the main program language [5].

2.2 WEB Server

In generally, server could be defined as the center and used as the "servant" which is useful to the data delivery or data received, and also to arrange the delivery and demand data between the connected computers, in other words server is used to provide the service to the client. Meanwhile the Web Server is a form of server which is used specifically to save the website page or home page [6].

2.3 PHP

PHP (PHP Hypertext Processor) is a scripting language in HTML. Most of the syntax are similar with the C language, Java, and Perl, and some of the specific PHP functions. The main purpose of the using of this language is to enable the web creator to write a dynamic web page fast [7].

2.4 MySQL

MySQL is one of the most popular kind of database server. The popularity is caused by MySQL is using SQL as the basic language to access its database. SQL is a concept of database operation, especially in choice or selection and data input, which is enable the data operation to be done easily and automatically [8].

2.5 Apache JMeter

Apache JMeter application is a an open source software, 100% pure Java application, which is created to load the behaviour of functional test and to measure the performances. At first, it was created to test the Web Application, but then expanded to test the other functions. Apache JMeter could be used to test the performances either in static or dynamic resources (Web services (SOAP / REST), Web dynamic language - PHP, Java, ASP.NET, File, etc [9].

2.6 Wireshark

Wireshark is a Network Packet Analyzer application which will try to catch or filter the packets which exist in a network and trying to show all the information in that packets very clearly. The filtered packets could be used to analyze a network. The analysis of network performance included many things, start from the process of catching the data packets or the information through the network, check the network security and the troubleshooting, and even for sniffing (get the important information such as password, privacy data, etc.). Wireshark is an open source for Network Analyzer. The appearance of Wireshark is using GUI (Graphical User Interface) [10].

3 Research Methodology

3.1 General Overview of the System

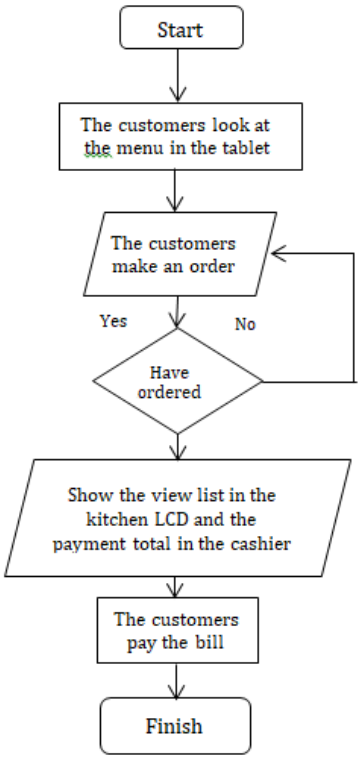

Fig. 1. System Flow Diagram of E-Canteen

Figure 1 shows the flow system from the beginning when the customer open the web system of menu list in the tablet which already available in each tables. Then the customers look at the menu in that show in the tablet when they want to make an order. If the customers already made an order, the order list will be sent to the kitchen to process their order, and to the cashier to count their payment. LCD in the cashier and kitchen will show the customers' order list in a real time, that the kitchen LCD will show the order view list, while in the cashier will show the order view list with the total payment. After the customers pay the bill, the flow system is done.

3.2 Measurement Scenario

The measurement scenario that will be conducted in measuring the performances of raspberry web server and network quality is QoS parameter, either when using the raspberry WiFi or wireless network adapter, as shown in figure 2.

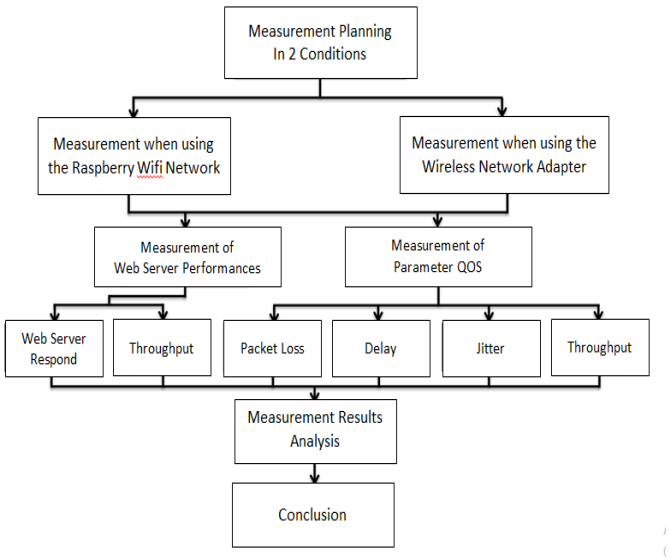

Fig. 2. Measurement Scenario.

4 Results and Discussion

4.1 The Implementation of Device System

4.1.1 The Implementation of User Interface

The user page is a page for making an order from the menu by the customers, which could be opened after going through the log in process. The options in user page are home, food and drinks pictures.

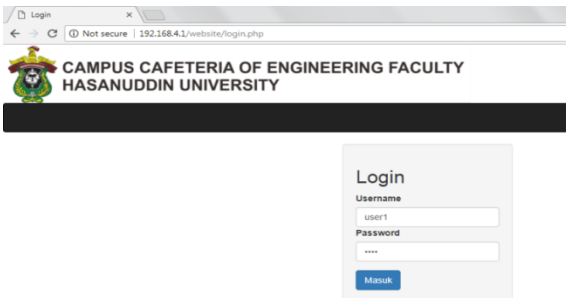

Fig. 3. Login User

Login menu is used to input the username and password of the customer's table. Login is used as the system authentication for the user who may to access it. If the login data that had been input is valid, then the user will enter the homepage of the website.

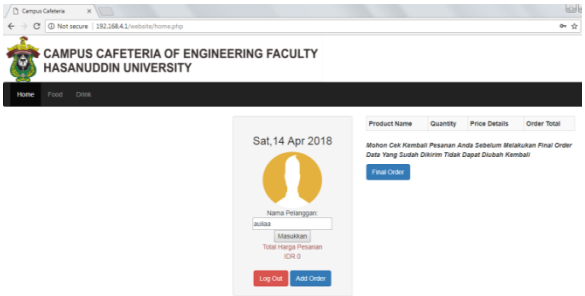

Fig. 4. Home User

In home user screen, there are buttons to enter the customer's name, add order, final order, and log out:

1. Enter the customer's name to input the customer's name.
2. Add order to move to the next page and see the menu list.
3. Final order to end the order process.
4. Logout is a sign that the user is ending the system.

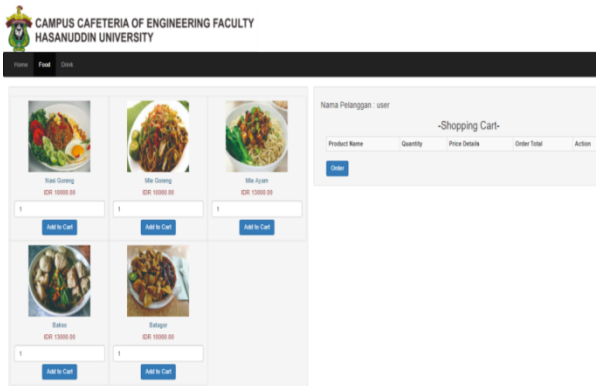

Fig. 5. The view of food and drink

In the view of food and drink, there are buttons:

1. Add to chart
   Add to chart to choose the food and drink that customers want.
2. Quantity
   Quantity determines the amount of food and drink of customer's order.
3. Order
   Order will send the order data of customers to the cashier and kitchen.

After the customer order the food and drink by click the order in user page, then the customer will back to the home user page to re-check the order list.

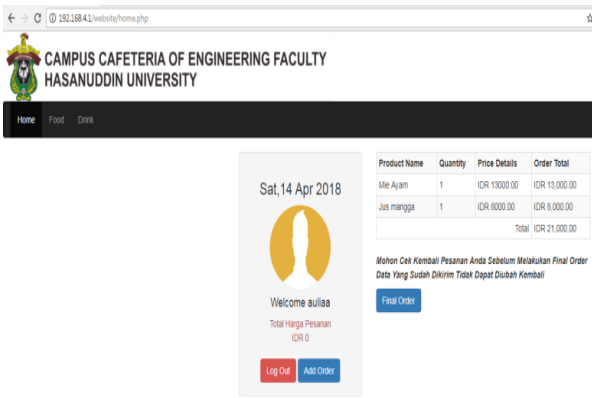

Fig. 6. The view of *Home User*

After re-check the order list in *order,* the customer will click the *final order* to end the order process. Then the order data will be sent to the kitchen and cashier.

4.1.2 The Implementation of Kitchen Interface

The kitchen page is a page which could be used to check the order list from the customers. The options in kitchen page are the order view, food management, and drink management.

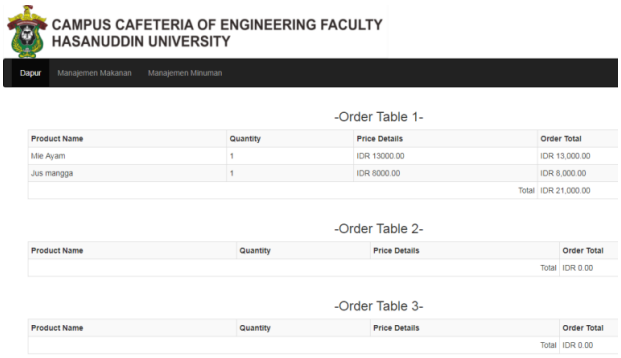

Fig. 7. The view of kitchen page

In kitchen page shows the order list of the customers. As follows in the table:

1. Product name: the order list of food and drink from the customer
2. Quantity: the amount of the order
3. Price details: the price of food and drink that had been ordered by the customer
4. Order total: the payment total of the customer's order.

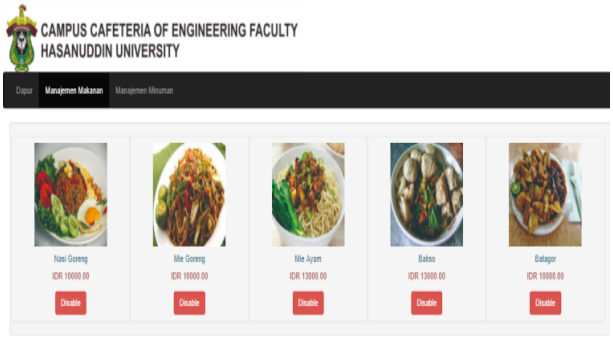

Fig. 8. Food and drink management

Food and drink management is a view of kitchen page which is used to make the food or drink is disabled in the page of user menu. If the kitchen make the food or drink disable, the customer could not order it from the menu.

4.1.3 The Implementation of Cashier Interface

The cashier page is the page which is used by the admin. In this page, the admin will process the payment transaction of the customer, arrange the menu that will show in the page, also to save the customer's order data which will be used as the order database. This page will be opened after going through login process.

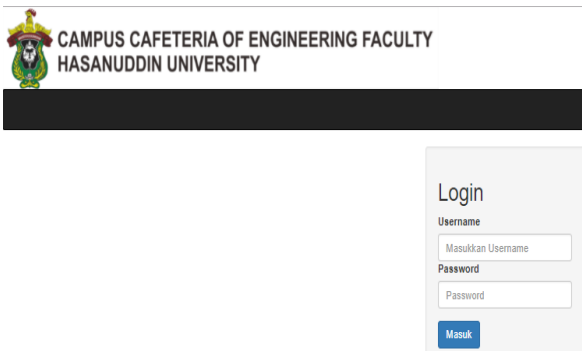

Fig. 9. The view of *Login Admin* page

Login is used to input the username and password for admin. This login is an authentication system for the user who may to access it. If the login data which had been input is valid, then the user will enter the cashier website page.

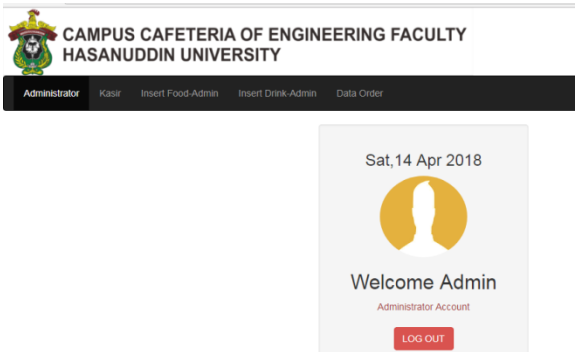

Fig. 10. The view of Admin page

After login, then the view of admin page will appear. This page has logout button which is used by the admin to exit from the page.

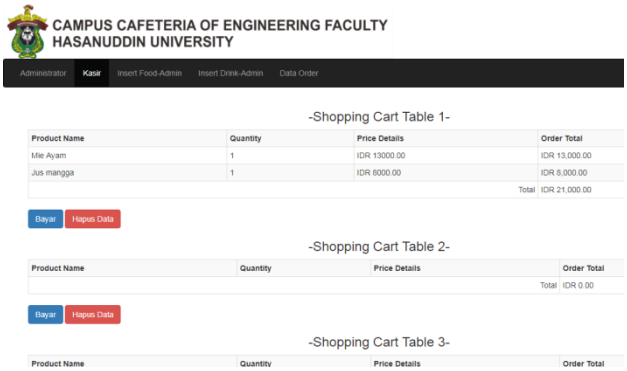

Fig. 11. The view of cashier page

In cashier page, there are pay and clear data buttons. The pay button is used when the customer already paid the bill. While the clear data button will delete the data on cashier and kitchen page.

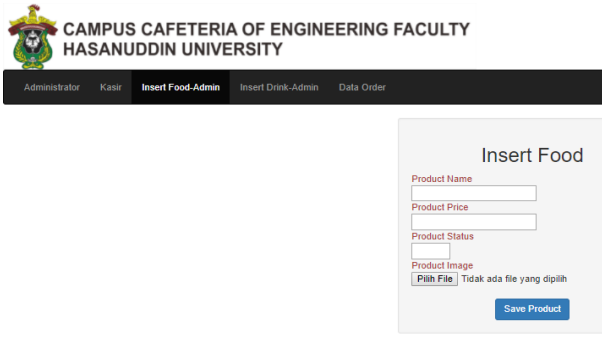

Fig. 12. The view of *insert food* and *insert drink* page

Insert food and insert drink is a page to add the food or drink menu on e-canteen order system. The data which need to be input are:

1. Product name
2. Product price
3. Product image

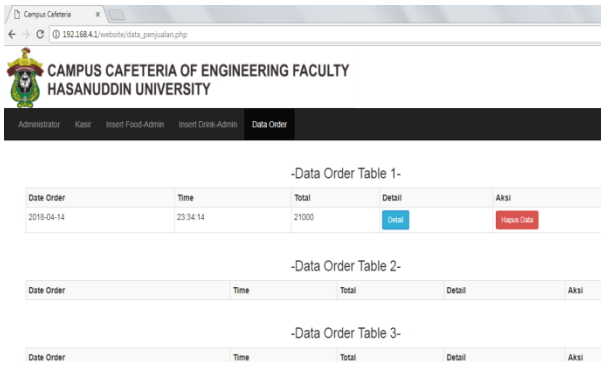

Fig. 13. The view of Data Order page

The database of order from the customer could be check again by the admin on data order page. The data order page will show the information as follows:

1. Data order: the view of customer order list
2. Time: the customer's times of order
3. Total: the total amount of customer's order
4. Detail: the order details of the customers

4.2 The Response Testing Of Web Server

The testing is conducted in two conditions, which the first condition is using the WiFi network on Raspberry, while the second condition is using the wireless adapter, which is ARGtek ARG-1209. The parameter which are being tested are *Average, Min, Max, Throughput,* and *request status*. The test result of both conditions according to the response analysis of Web Server are:

1. The average graphic of response time from the observation results.

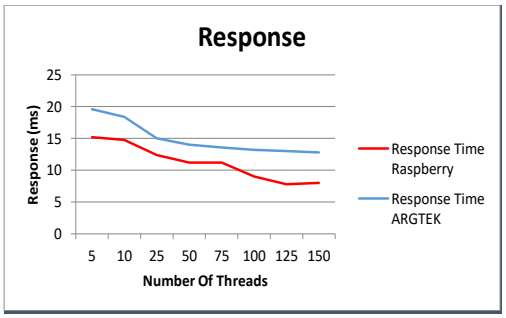

Fig. 14. Average Graphic of *Response time*

2. The average graphic of throughput from the observation results.

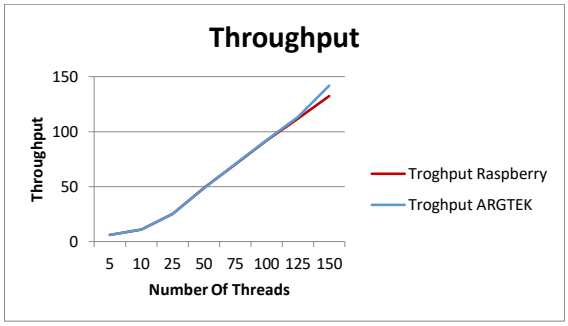

Fig. 15. Average Graphic of *Throughput*

Based on the graphics of both conditions above, it could be seen that there is a difference when using the raspberry WiFi network and the wireless network adapter. In the testing, the result of response time when using the raspberry WiFi network range around 8 ms – 15.2 ms. And when using the wireless network adapter, the response time range around 12.8 ms – 19.6 ms. The highest response time from both of the conditions is on 5 number of threads (client), which is for the Raspberry WiFi with 15.2 ms, while in the ARGtek is 19.6 ms, therefore based on that results a better response time is when using the Raspberry WiFi network.

The biggest throughput value when using the raspberry WiFi network is 132.33/sec, and when using the wireless network adapter the troughput value is 141.86/sec with 150 number of threads, while the lowest troughput value when using the raspberry WiFi network is 6.04/sec and when using the wireless network adapter the throughput value is 6.06/sec with 5 number of threads. For the testing of 5-150 number of threads, the condition of throughput could be seen that the more sample is sent, then the request will be faster for each seconds, which is caused by the server that tend to maintain the response time as soon as possible, but the increasing still occur in the throughput. In throughput, the higher throughput value will be better. It means that the server could execute many requests per time.

Based on the test results, it reveals that the web server performances in the first condition is better on responding the request which is showed by a less response time value than the reponse time value in the second condition, with a difference of 4.4 ms. While the second condition has a better condition than the first condition, which is showed by the throughput value which is bigger than the throughput value in the first condition, with a difference of 0.02-9.5/s.

4.3 QoS Testing

The following Table 1 gives a result data of QoS Parameter measurement by using Raspberry WiFi.

Table 1. Index value of QoS by using Raspberry WiFi

Total User	QoS Parameter	Measurement Result	TIPHON standard	Index
2	Packet Loss (%)	0	Very Good	4
	Delay (ms)	44.6716	Very Good	4
	Jitter (ms)	1.4112	Good	3
	Throughput (kbps)	149.8	Good	3
3	Packet Loss (%)	0	Very Good	4
	Delay (ms)	45.1276	Very Good	4
	Jitter (ms)	1.4386	Good	3
	Throughput (kbps)	146.6	Good	3
4	Packet Loss (%)	0	Very Good	4
	Delay (ms)	46.8872	Very Good	4
	Jitter (ms)	0.785	Very Good	4
	Throughput (kbps)	144.4	Good	3

The following Table 2 gives a result data of QoS Parameter measurement by using Wireless Network Adapter.

Table 2. Index value of QoS by using Wireless Network Adapter

Total User	QoS Parameter	Measurement Result	TIPHON standard	Index
2	Packet Loss (%)	0	Very Good	4
	Delay (ms)	32.9098	Very Good	4
	Jitter (ms)	0.7954	Very Good	4
	Throughput (kbps)	208	Good	3
3	Pakcet Loss (%)	0	Very Good	4
	Delay (ms)	34.2178	Very Good	4
	Jitter (ms)	1.0404	Good	3
	Throughput (kbps)	201.8	Good	3
4	Packet Loss (%)	0	Very Good	4
	Delay (ms)	36.7262	Very Good	4
	Jitter (ms)	0.7884	Very Good	4
	Throughput (kbps)	185.8	Good	3

By looking on the index table of QoS, to determine the QoS value is by divided the index total from QoS parameters with 16, then the index value of QoS for each conditions are as follows:

1. The index result value of QoS when using Raspberry WiFi by making request is 14/16 = 0.875 x 100% = 87.5% with the index value is 3 which means that the QoS value is in the good category.
2. The index result value of QoS when using Wireless Network Adapter by making request is 15/16 = 0.9375 x 100 % = 93.75 % with the index value is 3 that means the QoS value is in the good category for the total user 2 and 4. For the total user 3 the index result of QoS is: 14/16 = 0.875 x 100% = 87.5% with the index value is 3 which means that the QoS value is in the good category.

5 Conclusion

From this research, it could be concluded that:

1. E-Canteen could help to solve the long queue lines problem in ordering and payment process.

2. The test result reveals that the web server performance shows a good response in handled many clients either when using the Raspberry Pi WiFi network or Wireless network adapter. It could be seen from the condition of throughput which the more sample is sent then the request will be more faster, and in the throughput, the higher value of throughput will be more better. It means that the server could execute many requests per time.

3. The testing result of QoS when using Raspberry WiFi network and wireless network adapter ARGtek ARG-1209 have shown the index value is 3 which means that QoS value on web access analysis when using Raspberry WiFi as well as Wireless network adapter ARGtek ARG-1209 type is in good category

with 87.5% of QoS for Rspberry WiFi and 93.75% of QoS for ARGtek ARG-1209 Wireless Network Adapter, respectively.

6 Future Works

There are many things that could be conducted to improve this research in the future, which are:

1. The making of this E-Canteen still in a simple category, especially from the appearance and security, therefore it is expected to be more interesting in the further improvement.
2. The design of this E-Canteen is expected to be more interactive to make the information needed by the customer more useful.
3. The availability of facilities that can handle the payment process.
4. Provide big scree (display) for promoting foods and drinks and CCTV for safety reason to support E-Canteen.

Acknowledgement

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