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Websocket to Support Real Time Smart Home Applications

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Abstract

As we already know, the IoT (Internet of Thing) system has developed and is used in many fields, such as agriculture, security, industry etc. The IoT system requires real time monitoring and this is one of the problems that exists today. Transfering data from the sensor via the internet network to a monitoring device must be less than 300 ms. One process that can cause non-fulfillment of these requirements is a method for displaying the data on a monitor. There are several methods for delivering data from the sensor to a monitor. This paper has been compared between two methods, namely the polling method and the websocket method. The experiment was conducted to compare these two method. The result obtained that the websocket method was better in presenting real time data compared to the polling method. It can be shown in bandwidth usage and memory usage. In the experiment was found that the average of bandwidth usage is 478KB for polling method, and 91KB for web socket method in web based and the memory consumption of websocket less as much as 16% compared to polling method. In android smartphone the average bandwidth usage is 5.1 KB for web socket method and 15 KB for polling method and the memory consumption of websocket less as much as 22% compared to polling method.

Keywords: Websocket; realtime; IoT; smart home; polling method;

1. Introduction

In the twenty-first century, technological development is very rapid, everyday life cannot be separated from the subject of internet technology and also devices that support the running of business processes that provide new values that are very promising in terms of work efficiency and productivity. high level, among others, the computerization process in the form of internet-based company inventory, corporate bookkeeping applications that can be accessed from anywhere and anytime [1 3].

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As time goes on, computer technology is not only used as a conventional means for processing data but also as a means of monitoring, tracking and security systems for smart home that need to be monitored to increase the security. Integration of wireless communication technology with sensor and receiver modules can produce related information which called IOT (Internet of Things) system[2]. Advances in environmental wireless technology and internet map capabilities have greatly assisted the development of Web Services in monitoring and tracking solutions. Various types of software and systems were developed for monitoring system and tracking system for security purpose with visualization analysis[4 5] . In the other side, as the increase in Smartphone devices utilized by various users can provide an information source, for example, the depiction of position and status of home appliance[6].

IOT is a system consisting of several electronic devices which are put together including software and sensors to detect objects[7]. Objects can be controlled remotely through an existing internet network infrastructure, therefore the object's state can be monitored through a web that can be displayed on a laptop or mobile smartphone. Thus it is expected that IOT system can monitor and control objects, as a result it can increase the efficiency and accuracy of an object automatically. Accordingly the application and usability of IOT can be applied to almost all areas of life such as to monitor the environment, improve the efficiency of energy use, monitor health systems, monitor activities related to transportation and monitor the state of equipment at home or smart home[8 9].

The IoT was introduced since about twenty year ago, but there is no standard of architecture or frame work to build IoT System, including the method to transmit raw data into server and retrieved by user. Many research groups more focus on application protocol to increase performance of system communication[10]. Most of them focus on IETFs CoAP, IBMs MQTT, HTML 5s Web socket. They measure and argue about suitability for the IoT by considering reliability, security, and energy consumption aspects.

The IoT system must be able to present data and information from the sensor to the administrator or user in real time. In here, real time means that the delay from the sensor reading to the user's screen, should not be more than 300 ms. This is one of the problems in the IoT system[11]. Besides bandwidth speed, another problem is the technique of displaying data and information from the server to the user. There are several ways to send data and information from the sensor to the database server and display it on a smartphone or laptop[12]. Two ways that are often used are pooling techniques and websocket techniques. In this study, we analyzed the two techniques which our hypothesis is that the web pocket method is better in performance than the pooling method. After the experiment, it turns out that it is true that the websocket method is better than the pooling method. Then we can concluded that websocket method is a good method in exchange data between webserver and mobile devices in IOT system to support realtime applications, specifically for smart home.

2. Theory and literature review

2.1. Polling method

Polling is an HTTP data exchange method or web traffic where the polling method utilizes the request and response method from HTTP in general, the client - side constantly repeats the HTTP protocol starting from the requesting the file from the server within a certain interval period and the server responding to the client.

HTTP Polling is the easiest method of simulating a push server implementation. In the request and response process itself has a setting of waiting time called interval polling, which is the waiting time between two requests from the client to the server. If no update received then the response to the request is requested without a message, but if you have an update the response to the request will be replied with the new message. The characteristics of real-time polling have disadvantages because the update message is very dependent on requests and vulnerable to delays, but if the interval polls are minimized, it will minimize the delay as well so that it is suitable for small-scale applications. The advantage of its own polling characteristics is that it is very easy to implement which does not require additional extensions to support the polling method just holding on to a timer at certain intervals. (Shuang & Feng, 2013). The workflow that is more detailed in the polling method is illustrated in Fig. 1.

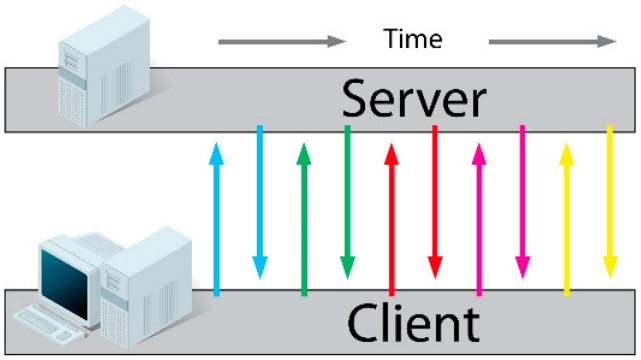

Fig. 1: Polling method ilustartion.

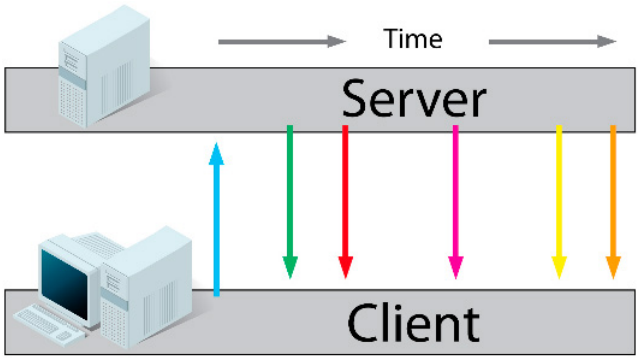

Fig. 2: Websocket method ilustartion.

2.2. *Websocket method*

Websockets are HTTP data exchange methods or web trafficking where the websockets method utilizes the request and response method from HTTP in general but client-side requests to open open-connection status with the server so that the server and client can communicate and exchange two-way data when there is new data available in real time without repeating the entire HTTP protocol. In this study websocket and polling methods are compared because the websocket method requires a higher browser specification and imposes latency on the server and there are several issues such as security and mixed content handling with http but offers higher speed and efficiency [13].

Websockets itself is a technology that provides a path of its own in supporting two-way communication (full-duplex bi-directional) in one TCP protocol, but websockets requires compatibility support from the server side and also the client browser to websocket procedures. The advantage of websockets itself is increasing bandwidth efficiency and utilization but also has disadvantages, namely requiring stable TCP in maintaining connections and not supported by all browsers and web servers [14]. The workflow that is more detailed in the websocket method is illustrated in Fig. 2.

3. Methodology

In this study, we designed an IoT system as shown in Fig. 3. IoT system starts with a sensor that will retrieve data according to the function of the sensor itself. Sensor is a device which detects or measures a physical property and records, indicates, or otherwise responds to it. Sensor will be installed in a mini computer. The data will be processed in mini computer and the results will be sent to the database through gateway. In this study we designed and built a web and data server and applications for smart phones and laptops along with their features. Data and information

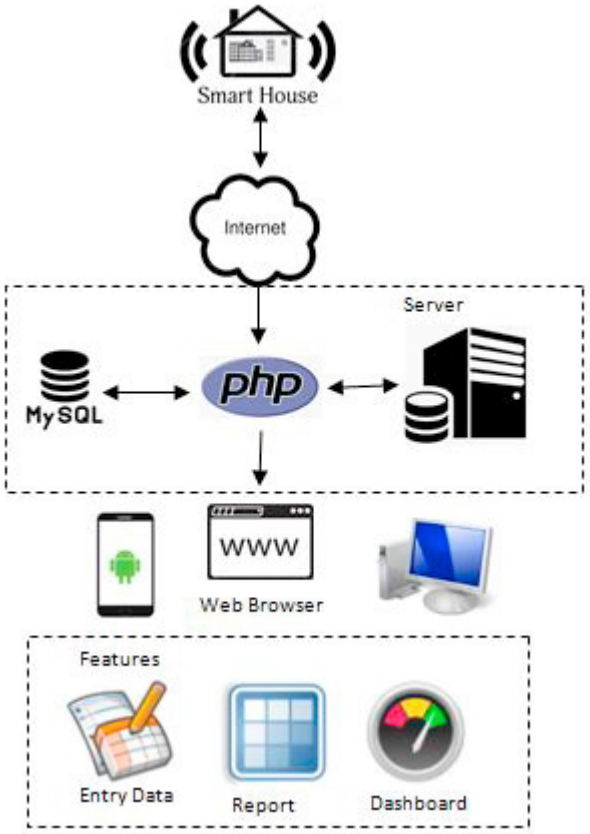

Fig. 3: Basic design of IoT system.

from the sensors on the smart house system will be sent through the existing internet network infrastructure to the data base server. Then the data on the server will be displayed on a mobile smart phone or laptop using a web browser.

Data collection to support the analysis and evaluation process in the study will be carried out by measuring a number of benchmarks to prove whether the websocket method is better than the measurement polling method, including measuring traffic from each method for 60 seconds as many as 40 times on the two roles in the system includes admin roles on the laptop, and also a user role on Android smartphone, some of which measure the traffic in terms of packet, in terms of bandwidth used and also memory consumption. In the web admin console section, measurements will be taken of the packets received, bandwidth used every 60 seconds, and measurements of the average bandwidth used per second and the amount of memory consumption used.

Measuring Traffic on the laptop will use tools called ”Wireshark Network Analyzer” to monitor the web admin admin traffic. While to measure memory consumption used will use the tools ”Chrome Task Manager” to see the memory consumption used, these tools will help in monitoring and measuring with a number of benchmarks needed such as the number of packets of data received, and also bandwidth usage used.

In the android smartphone application a measurement of packet data traffic and the bandwidth used have been analyzed in both methods every 60 seconds. Measurement of traffic in android smartphone applications is measured by using tools ”tPacketCapture” to monitor data packets and the amount of bandwidth sent by both methods, and use the ”Application Manager” of the android operating system to measure memory consumption used by polling applications and the websockets method.

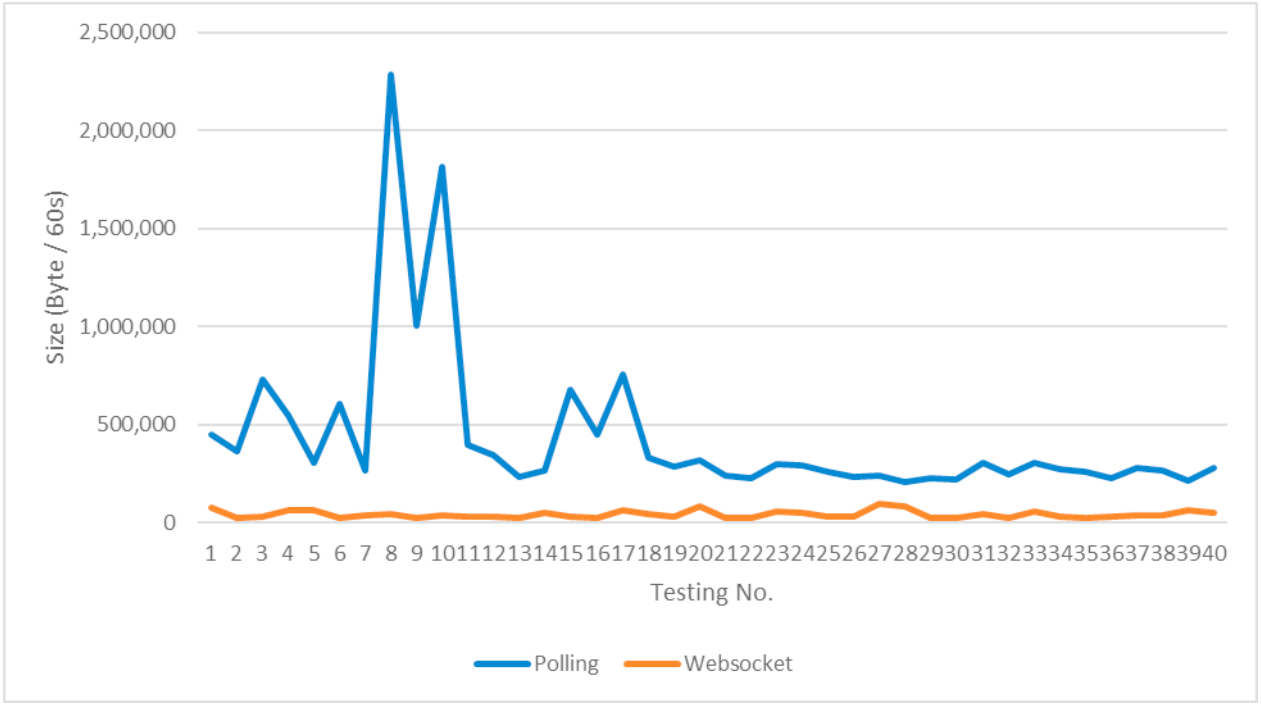

Fig. 4: Comparison of bandwidth consumption on web based.

4. Results

Based on all the measurement results obtained, the comparison of the bandwidth usage required between the polling method and the websocket method as many as 40 times experiments on the web based can be seen in Fig. 4, while Fig. 5 is a comparison of bandwidth consumption on the android smartphone.

In fig. 4 is comparison of consumption or bandwidth usage for web based. In the figure, it can be seen that web socket method is very stable in bandwidth usage. Since the first experiment to the 40th experiment the usage bandwidth less than 100KB. In addition, bandwidth usage in web socket method is smaller than the polling method. In the polling method, usage bandwidth more than 200KB and had some burst bandwidth consumption between the 7th experiment to 18th experiment, the burst can be up to 2.5MB. The average of bandwidth usage is 478KB for polling method, and 91KB for web socket method in web based.

In fig. 5 is comparison of consumption or bandwidth usage for android smartphone. In the figure, it can be seen that the web socket method is more perform compared to polling method. Both method have the similar pattern but the web socket method need less bandwidth than polling method. The average bandwidth usage is 5.1 KB for web socket method and 15 KB for polling method in android smartphone.

All measurement the memory consumption results which obtained on traffic can be concluded to be the average value to compare the performance of the websocket method and the polling method. For a comparison of the performance and memory consumption of the websocket method and the polling method in the web based, it will be shown in the table 1, while the performance comparison of the websocket method and polling method in the android smartphone application system will be shown in the table 2.

In table 1 showing the memory consumption of websocket method is less than memory consumption polling method for web based. The polling method need 37 - 51 MB memory consumption or about 44 MB. Meanwhile the websocket method need 32 - 42 MB memory consumption or about 37 MB. In the other word, the websocket method need less memory as much as 16% compared to polling method for web based.

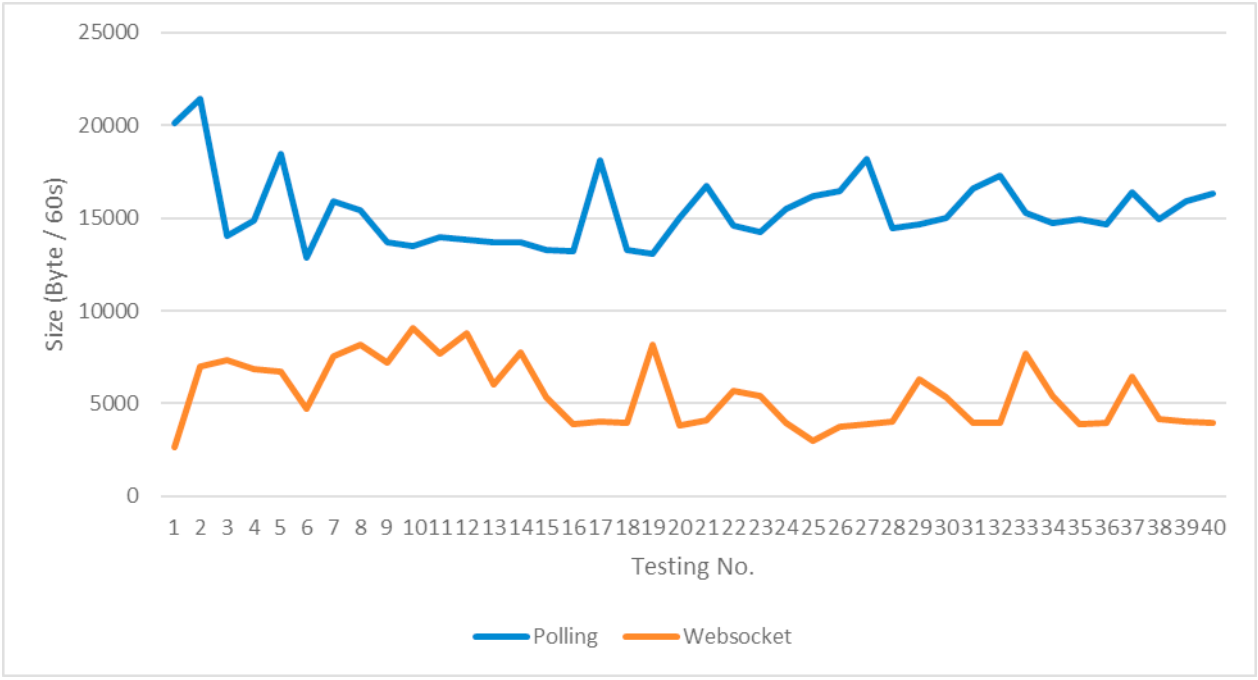

Fig. 5: Comparison of bandwidth consumption on android smartphone.

In table 2 showing the websocket method need 90 - 131 MB or 155 MB memory consumption and polling method need 98 - 145 MB or 121 MB memory consumption. It means that memory consumption of websocket method less 22% compared to polling method for android smartphone.

Table 1: Comparison of average traffic and memory consumption on web based.

Method	Average Packet Captured / 60s	Average Size (Byte / 60s)	Average Memory Consumption
Polling	2,474	437,973	37 - 51 MB
Websocket	198	41,854	32 - 42 MB

Table 2: Comparison of average traffic and memory consumption on android smartphone.

Method	Average Packet Captured / 60s	Average Size (Byte / 60s)	Average Memory Consumption
Polling	131	15,362	98 - 145 MB
Websocket	44,4	5489.9	90 - 131 MB

5. Conclusion

IoT system consists of several functional components in the form of hardware and software that can facilitate the transfer of data from sensors, processing data into information and displaying information on monitor equipment such as a laptop or smartphone. The problem that often arises is about displaying information in real time. In this study it has been shown that one process for displaying information can cause realtime cannot be fulfilled. This research has

been compared between two methods for displaying information, namely the polling method and websocket method. In the experiments that have been done, it was found that the websocket method is better than the polling method. In the web based environmental, the average of bandwidth usage is 478KB for polling method, and 91KB for web socket method, meanwhile the memory consumption of websocket less as much as 16% compared to polling method. In the android smartphone, the average bandwidth usage is 5.1 KB for web socket method and 15 KB for polling method and the memory consumption of websocket less as much as 22% compared to polling method.

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