PERFORMANCE COMPARISON ANALYSIS OF SPRINGBOOT AND LARAVEL FRAMEWORKS USING API WEB SERVICE

Rizky Yulianto [1*], Mardiana, Rio Ariestia P[3], Gigih Forda Nama [4]

[1,2,3,4] Informatics Engineering Universitas Lampung; Jl. Prof. Dr. Sumantri Brojonegoro No. 1 Bandar Lampung,; Telp (+62) 721 701609

Abstract. This study is meant to know difference in performance between web service built with Laravel and Spring Boot. To know the performance of both framework two web service is made with Representational State Transfer Application Interface or (REST API) as a common means to communicate to send data with Create, Read, Update, and Delete (CRUD) method to a similar database. The response time Performance from both of the framework is calculated by simulating usage that is 10000 request for each method Post, Get, Update, and Delete. The result from the test of Spring Boot and Laravel using Apache Jmeter is that with 10000 request using Postt, Get, Put and Delete method in order Spring Boot has request time advantage that is 44,8ms, 45,37ms, 109,5ms, 42ms compared Laravel 291,98ms, 301,2ms, 426,54ms, 273,06ms.

1.   INTRODUCTION

The use of information and communication technology that continues to grow, has a major influence on organizations and individuals in meeting information and communication needs. The ease of accessing information between devices and media is a very important function in the development of applications to become larger, therefore it is necessary to integrate systems that are interconnected in various platforms and devices that exist with one of the ways that can be chosen is the use of web services.[1].

Web service is a software application used for users to communicate with hardware as a means of storing and processing the information needed. Nowadays, web services have been widely used to facilitate various user interests, including educational, commercial, and government needs[2].

With those requirement, a web service needs to be built quickly and this can be done by using a framework. Representational State Transfer Application Interface (REST API) is a way how a client program can communicate with a web service where REST is an architectural style that is used in general for modern web services and APIs that will expose the data and functions needed by the client program.

Framework is a tool to make it easier for web service developers to build web services in a more efficient and higher quality way than using programming languages directly to process and store information from users who will later use the web service. This is because a framework itself consists of code that has been written by other web service makers which is collected and then assembled in such a way that the code can be reused by other web service makers to save time and effort without having to create a web service from scratch. For now, according to the Statista website, in the top 15 framework order, there is the Spring Boot

framework which uses the Java language and Laravel which uses the PHP language[3].

Spring boot is a Java framework that is a fraction of the Spring framework that focuses specifically on creating a web-based application. According to the spring.io website, Spring Boot makes it easier to build Spring-based applications by allowing webservice builders to work directly on building applications with minimal difficulty[4].

Laravel is a framework of the Hypertext Processor (PHP) programming language which is an opensource scripting language specialized for web development that appeared in 1995 created by Rasmus Lerdorf [5]. At first PHP was an acronym for Personal Homepage Tools. Laravel uses an elegant syntax that can make the development process extraordinary.[6].

Both frameworks have different performance from one another so a test is needed that will take data from the performance of web services developed using the two frameworks. For testing needs, an application called Apache Jmeter is used. Apache Jmeter is a testing software that focuses on testing web applications.[7].

Apache Jmeter is an open source testing tool and has enough features to test a web-based application. According to research by Rabiya Abbas et al. which compares several testing applications, the results obtained are that Apache Jmeter has advantages compared to other testing tools. In addition, Apache Jmeter also has a community that is still very active so that the addition of new features and bug fixes is quite often done by developers voluntarily. This research will carry out the design process of 2 web services using the Laravel and Spring Boot frameworks, each of which will be designed to process Create, Read, Update, and Delete (CRUD) data which will be sent through the Apache Jmeter testing application on the same database. The results of testing data for both web services in the form of response times will be taken and compared and are expected to be used as a reason why developers develop a web service application with the Laravel or Spring Boot framework.

2. LITERATURE REVIEW

2.1 Web Service
According to W3C (World Wide Web Consortium) Web Service is a software system designed to support machine-to-machine interaction over a network and has an interface that can be described in a format that is understood by the machine. Other systems that want to interact with Web Service usually use Hypertext Transfer Protocol (HTTP) or Extensible Markup Language (XML).[8]

2.2 Hyper Text Transfer Protocol (HTTP)
HTTP is a standard protocol used on the internet. It has lightweight and fast elements that are required by distributed hypermedia collaborative information systems. HTTP is characterized as an object-oriented protocol that has no state and contains a connection where the client will make to the server, Request is the sending of a request for information to the server by the client, Response is an answer from the server regarding the Request sent by the client. HTTP has several methods for sending data, namely GET which has a function to retrieve the data requested by the client, PUT has a function to change the data in the server requested with the data sent by the client, DELETE is a method used to request the server to delete the data requested by the client, POST is a method used to create new objects in the server..[9]

2.3 Rest API
API (Application Programming Interface) is a way for a client to communicate with a Web Service. APIs expose a collection of data and functions to facilitate interaction between computer programs and allow them to exchange information. [10]
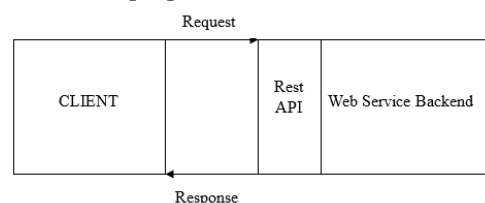

Fig. 1 API Diagram

2.4 Framework
A framework is a semi-complete application that can be specialized to create a custom application and can be reused to develop other

applications. Frameworks give developers a collection of framework components that have several characteristics: they work well with other applications, they are ready to be used in future projects, and they can be understood and used by other teams in the organization[10].

2.5 Spring Boot
Spring boot is a framework that uses the Java programming language. Spring boot makes it easier for all developers to do the development process by summarizing the process of configuring third-party libraries that will be added to the application being developed.[11]

2.6 Laravel
Laravel is a framework that uses the PHP language that came out in 2011. Laravel is a fast application development framework which means that Laravel focuses on easy learning curves and minimizes the steps needed to start new applications and publish applications that have already been created[12].

2.7 Performance testing
Performance testing is one part of the Software Development LifeCycle (SDLC) stage. This test is conducted to determine whether a system has met the non-functional needs contained in the Software Requirement Specification (SRS) document or not. Performance testing can be done by measuring the response time and throughput of a web application[13].

2.8 Apache Jmeter
Apache Jmeter is an open source application that is used to measure the performance of this application. Apache Jmeter has a function called listener that can monitor the performance matrix to measure response time and percent of errors. Response time is defined as the total time required for a web service to serve a request made by a client to a web service and is measured in milliseconds[14].

2.9 XAMPP
XAMPP is an opensource application used to install an Apache Web Server which can then be used to run web applications in a local environment[15].

3.   RESEARCH METHOD

3.1 Tools and Materials
The research tools and materials used can be seen in table 3.1

Table 1 Research tools and materials

No	Name	Specification	Description
1	Laptop Asus X441UB	Intel® CoreTM i3-6006U with RAM 8GB and operating system Windows 10	Hardware used to perform the application development process
2	Intellij Idea	Version 2023.1	Software used for Java application development
3	Visual Studio Code	Version 1.81.1	Software to perform Laravel application development
4	Java	Version 18.0.1.1	Programming language for developing applications with the Spring Boot framework

5	Springb oot	Version 3.0.1	Java framework for developing Web-based applications
6	Apache Maven	Version 3.8.6	Software for managing Java projects
7	PHP	Version 8.2.10	The programming language used to develop framework applications with Laravel
8	Laravel	Version 10.1.7	PHP framework for developing web applications
9	Apache Jmeter	Version 5.6.1	Application for testing web services
10	MariaD B	Version 10.4.28	Database to store the transmitted data.

3.2 Research Stages
In this research, a quantitative method is used to measure the performance comparison between the two web service applications to be built. These two applications will be tested based on the response time measured by the Jmeter application.
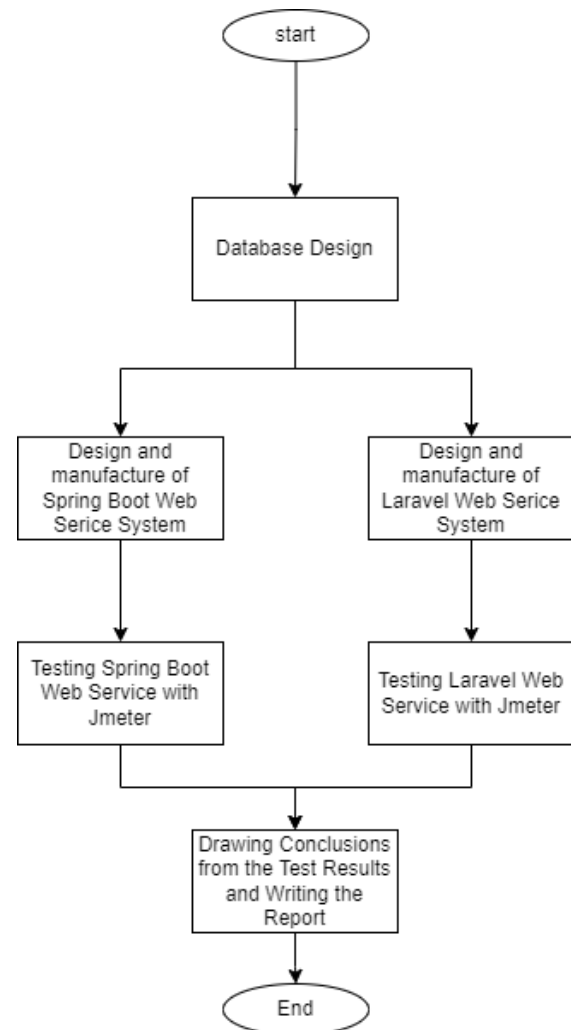
Fig. 2 Research Stages

3.2.1 Database Design
The database is used to store information that will be stored and accessed by users through the API that will be created. The database will have several fields, namely id with integer type as Primary key, address with varchar type, email with varchar type, name with varchar type, no_hp with varchar type, and finally password with varchar type. In its application, both Spring Boot and Laravel frameworks will be connected to the same MariaDB database as data storage.

3.2.2 Web Service Design
At this stage, two web services will be designed with each Spring Boot and Laravel frameworks with the same functionality, namely the creation of an API with 4 Controller endpoints POST, PUT, GET, DELETE, each of which has the Create, Update Read, and Delete functions to manipulate data contained in the database that

has been designed. Both web services will be created following the same class diagram in Figure 3.2.
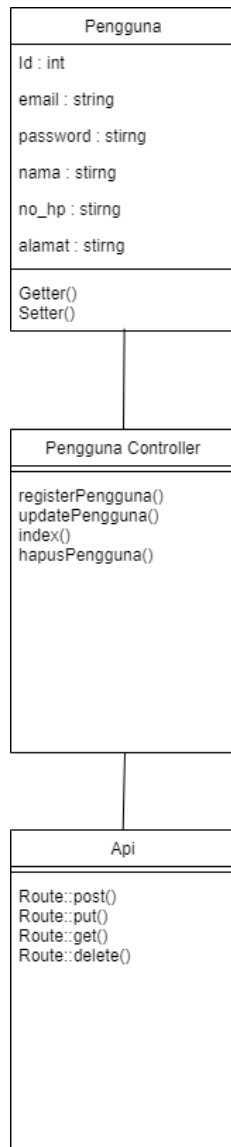

Fig. 3 web service class diagram

Both web services will be created using the default configuration provided by the framework developers.

3.2.3 Testing With Jmeter

At this stage the web service that has been designed will be run in a local environment and then tested using the Apache Jmeter application with the number of 10000 requests for each endpoint of the 4 API controllers owned by each web service. the description of the testing flow can be seen in figure 3.4
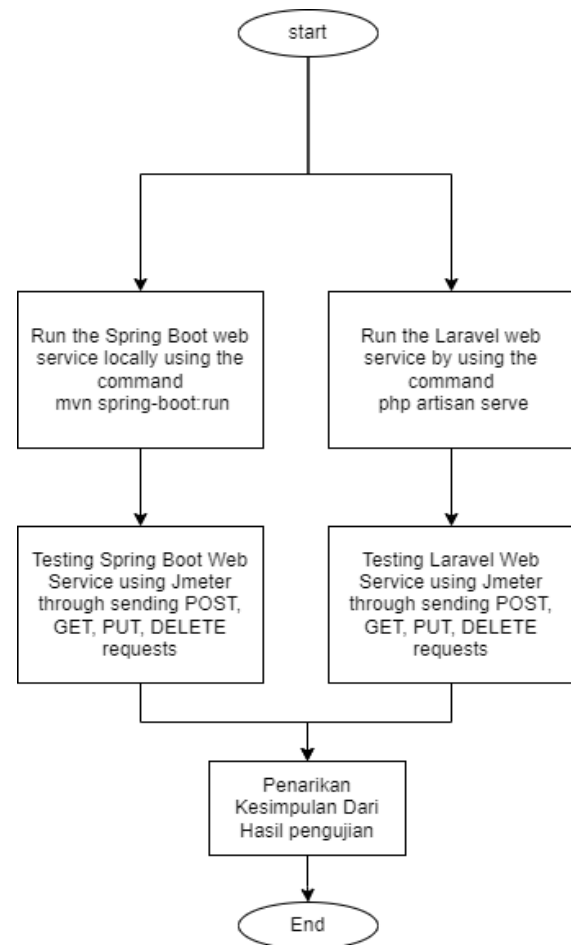

Fig. 4 Test design flow using Jmeter

From Figure 3.3, it can be seen that the testing phase begins with running the web service application that has been created locally. . Each built-in server is run using the default configuration settings. Testing between web services is done separately so that the results obtained are not affected by the consumption of shared resources. In testing each method, the same data will be sent to be stored in the database of each web service.
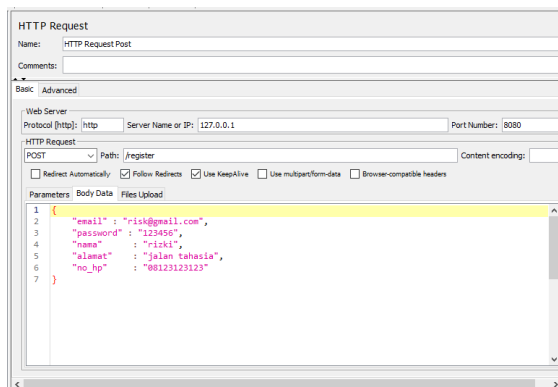
Fig. 5 data *request POST*

From Figure 3.4 it can be seen that the web service will be run locally with and the address for the POST method endpoint is register. Then for the String that is sent is the value of several keys, namely email, password, name, address, and no_hp which will later be saved into the database connected to each web service.
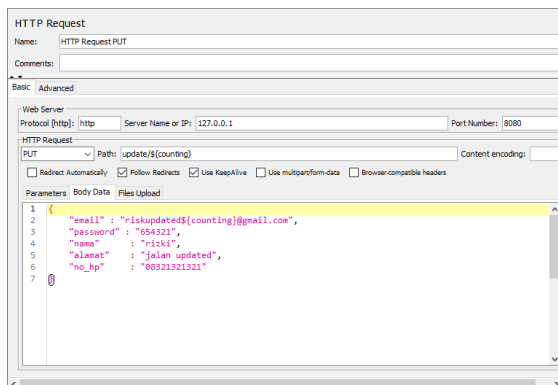

Fig. 6 data *request PUT*

In Figure 3.5, it can be seen that the put test method will change the data on the email key. In contrast to POST testing, PUT testing requires additional parameters, namely the id parameter which is the primary key in the database as a reference for the data to be changed.
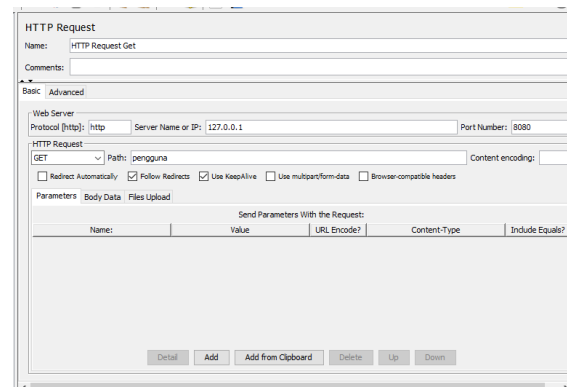

Fig. 7 data request *GET*

From Figure 3.6, it can be seen that testing the GET method does not require data to be sent because in this method.
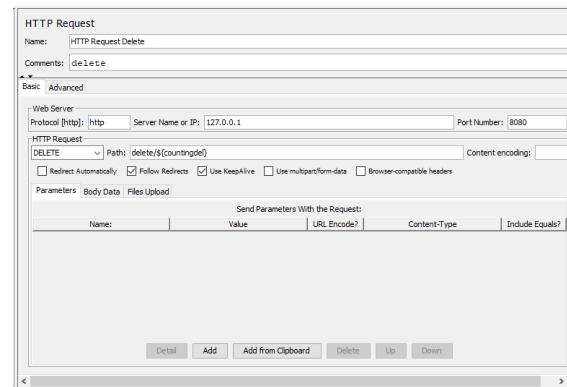

Fig. 8 data request Delete

In Figure 3.7 can be seen is the data needed for the DELETE method. In this method, just like PUT, the id parameter is needed to find the data to be deleted from the database.

3.2.4 Conclusion Drawing
At this stage the results obtained from the testing stage with the Apache Jmeter application will be collected and the average calculation obtained by each web service will be calculated after it is obtained, conclusions will be drawn about the test results obtained to be written into the final report.

4. RESULTS AND DISCUSSION

In tests carried out using the Post, Put, Get, and Delete methods, 1000 data will be sent in the form of Javascript Object Notation (JSON). Which contains strings from several sentences using predetermined endpoints

4.1 Test Results of Post Method

Table 4.1 Test Result Of Post Method

	Average	Min	Max	through put	Eror Rate	Receive KB/sec	Sent KB/sec
Spring boot	44,804 ms	14 ms	1626 ms	22,2/sec	0%	6,30	7,41
Laravel	291,98 ms	229 ms	2116 ms	3,4/sec	0%	1,46	1,16

From table 4.1 it can be seen that Spring Boot has an advantage over Laravel in the average, lowest, and highest values of response time which are 44.804ms, 14ms, 1626ms respectively.

4.2 Test Result of Put Method

Table 4.2 Test Result of Put Method

	Average	Min	Max	through put	Eror Rate	Receive KB/sec	Sent KB/sec
Spring boot	45,03 ms	15 ms	568 ms	21,9/sec	0%	6,46	7,60
Laravel	301,20 ms	231 ms	5113 ms	3,3/sec	0%	1,48	1,16

From table 4.2 it can be seen that Spring Boot has an advantage over Laravel in the average, lowest, and highest values of response time which are 45.03ms, 15ms, 568ms respectively.

4.3 Test Result of Get Method

Table 4.3 Test result of Get method

	Average	Min	Max	through put	Eror Rate	Receive KB/sec	Sent KB/sec
Spring boot	109,5 ms	99 ms	1465 ms	9,1/sec	0%	11567,18	1,12
Laravel	425,54 ms	391 ms	1540 ms	2,3/sec	0%	2970,52	0,28

From table 4.3 it can be seen that Spring Boot has an advantage over Laravel in the average, lowest, and highest values of response time which are 109.5ms, 99ms, 1465ms respectively.

4.4 Test Result of Delete Method

Table 4.4 Test Result of Delete Method

	Average	Min	Max	through put	Eror Rate	Receive KB/sec	Sent KB/sec
Spring boot	42,20 ms	16 ms	860 ms	23,6/sec	0%	2,78	4,95
Laravel	273,06 ms	221 ms	1245 ms	3,7/sec	0%	1,17	0,78

From table 4.4 it can be seen that Spring Boot has an advantage over Laravel in the average, lowest, and highest values of response time which are 42.20ms, 16ms, 860ms respectively.

In addition to this 10000 requests test, the advantages of the Spring Boot framework are also consistently seen in tests for 1000, 3000, and 5000 requests which can be seen in the following link:

https://drive.google.com/drive/folders/15iq0e2xZHI_H3NrbvJN9f1_rM0LdPFhp?usp=drive_link

5.   Conclusion

The conclusions obtained from this research are as follows:

1. From the tests carried out, the number of responses and response times of the two web services built using Spring Boot and Laravel were taken. It was found that at 10000 requests with Post, Put, Get, and Delete methods, Spring Boot has an average response time advantage of 44.8ms, 45.37ms, 109.5ms, 42.ms compared to Laravel which is 291.98ms, 301.2ms, 426.54ms, 273.06ms respectively. This superiority is also shown in tests using 1000, 3000, and 5000 requests.
2. The superiority of web services built with Spring Boot occurs because the Spring Boot web service framework by default downloads fewer dependencies than the dependencies that are downloaded by default in the Laravel framework.
3. Each framework can complete all test requests successfully. This is proven by the error rate of both frameworks having a value of 0% for each CRUD method.
4. Based on the data obtained in testing the GET Web Service Spring Boot method has the advantage of not only a faster average time Spring Boot can also send more data with 11567.18 KB of data per second.

REFERENCES

[1] "Analisis Perbandingan Performa Web Service Rest Menggunakan Framework Laravel, Django, Dan Node Js Untuk Akses Data Dengan Aplikasi Website | Jurnal Teknik Informatika." Accessed: Aug. 23, 2023. [Online]. Available: Https://Ejournal.Antarbangsa.Ac.Id/Jti/Article/View/515

[2] H. K. Dhalla, "A Performance Comparison Of Restful Applications Implemented In Spring Boot Java And Ms.Net Core," *J. Phys.: Conf. Ser.*, Vol. 1933, No. 1, P. 012041, Jun. 2021, Doi: 10.1088/1742-6596/1933/1/012041.

[3] "Most Used Web Frameworks Among Developers 2023," Statista. Accessed: Aug. 29, 2023. [Online]. Available: Https://Www.Statista.Com/Statistics/1124699/Worldwide-Developer-Survey-Most-Used-Frameworks-Web/

[4] "Spring Boot," Spring Boot. Accessed: Aug. 29, 2023. [Online]. Available: Https://Spring.Io/Projects/Spring-Boot

[5] "Announce: Personal Home Page Tools (Php Tools)." Accessed: Aug. 29, 2023. [Online]. Available: Https://Groups.Google.Com/G/Comp.Infosystems.Www.Authoring.Cgi/C/Pyj25gz6z7a/M/M9fktuvdfcwj?Pli=1

[6] "Laravel - The Php Framework For Web Artisans." Accessed: Aug. 29, 2023. [Online]. Available: Https://Laravel.Com/

[7] "Apache Jmeter - Apache Jmeter[tm]." Accessed: Oct. 30, 2023. [Online]. Available: Https://Jmeter.Apache.Org/Index.Html

[8] "Web Services At W3c: Web Service." Accessed: Aug. 31, 2023. [Online]. Available: Https://Www.W3.Org/2005/Talks/01-Ws-Plh/?N=1

[9] "Http: A Protocol For Networked Information." Accessed: Nov. 30, 2023. [Online]. Available: Https://Www.W3.Org/Protocols/Http/Http2.Html

[10] M. H. Massé And M. Massé, *Rest Api Design Rulebook: Designing Consistent Restful Web Service Interfaces*. Beijing Köln: O'reilly, 2012.

[11] T. Husted And C. Dumoulin, *Struts In Action: Building Web Applications With The Leading Java Framework*. Greenwich, Ct: Manning, 2003.

[12] M. Stauffer, "Laravel: Up And Running: A Framework For Building Modern Php Apps".

[13] R. Y. He, "Design And Implementation Of Web Based On Laravel Framework:," Presented At The 2014 International Conference On Computer Science And Electronic Technology (Iccset 2014), Shenzhen, China, 2015. Doi: 10.2991/Iccset-14.2015.66.

[14] S. Dhiman And P. Sharma, "Performance Testing: A Comparative Study And Analysis Of Web Service Testing Tools," 2016.

[15] S. Matam And J. Jain, *Pro Apache Jmeter*. Berkeley, Ca: Apress, 2017. Doi: 10.1007/978-1-4842-2961-3.