

Comparative Study: Performance of MVC Frameworks on RDBMS

M. H. Rahman*

Department of Computer Science & Engineering, Dhaka University of Engineering & Technology, Gazipur, Bangladesh

E-mail: hafizurfpbd@gmail.com

ORCID iD: <https://orcid.org/0009-0006-0517-9056>

*Corresponding author

M. Naderuzzaman

Department of Computer Science & Engineering, Sonargaon University, Dhaka, Bangladesh

E-mail: nader.u@gmail.com

ORCID iD: <https://orcid.org/0009-0004-0180-8703>

M. A. Kashem

Department of Computer Science & Engineering, Dhaka University of Engineering & Technology, Gazipur, Bangladesh

E-mail: drkashemll@duet.ac.bd

ORCID iD: <https://orcid.org/0009-0009-2055-6050>

B. M. Salahuddin

Department of Computer Science & Engineering, Jagannath University, Dhaka, Bangladesh

E-mail: fpsalahuddin@gmail.com

ORCID iD: <https://orcid.org/0009-0009-0318-5841>

Z. Mahmud

Department of Computer Science & Engineering, Jagannath University, Dhaka, Bangladesh

E-mail: zulfiker@cse.jnu.ac.bd

ORCID iD: <https://orcid.org/0000-0001-5177-6704>

Received: 11 June 2023; Revised: 13 August 2023; Accepted: 18 October 2023; Published: 08 February 2024

Abstract: The regular utilization of web-based applications is crucial in our everyday life. The Model View Controller (MVC) architecture serves as a structured programming design that developers utilize to create user interfaces. This pattern is commonly applied by application software developers to construct web-based applications. The use of a MVC framework of PHP Scripting language is often essential for application software development. There is a significant argument regarding the most suitable PHP MVC such as Codeigniter & Laravel and Phalcon frameworks since not all frameworks cater to everyone's needs. It's a fact that not all MVC frameworks are created equal and different frameworks can be combined for specific scenarios. Selecting the appropriate MVC framework can pose a challenge at times. In this context, our paper focuses on conducting a comparative analysis of different PHP frameworks. The widely used PHP MVC frameworks are picked to compare the performance on basic Operation of Relational databases and different type of Application software to calculate execution time. In this experiment a large (Big Data) dataset was used. The Mean values of insert operation in MySQL database of Codeigniter, Laravel, Phalcon were 149.64, 149.99, 145.48 and PostgreSQL database's 48.259, 49.39, 45.87 respectively. The Mean values of Update operation in MySQL database of Codeigniter, Laravel, Phalcon were 149.64, 158.39, 207.82 and PostgreSQL database's 48.24, 49.39, 46.64 respectively. The Mean values of Select operation in MySQL database of Codeigniter, Laravel, Phalcon were 1.60, 3.23, 0.98 and PostgreSQL database's 1.95, 4.57, 2.36 respectively. The Mean values of Delete operation in MySQL database of Codeigniter, Laravel, Phalcon were 150.27, 156.99, 149.63 and PostgreSQL database's 42.95, 48.25, 42.07 respectively. The findings from our experiment can be advantageous for web application developers to choose proper MVC frameworks with their integrated development environment (IDE). This result will be helpful for small, medium & large-scale organization in choosing the appropriate PHP Framework.

Index Terms: Database, Framework, Insert, Update, Select, Delete.

1. Introduction

Web development is the top choice among programmers due to the demand world-wide. Majority of the application developed are dynamic and need to communicate with relational database systems. In web development the programmer must consider the performance of the application software in terms of accessing data to and from a relational database with integrated development environment (IDE). Many research has been carried out to find the optimal performance by choosing perfect combination of MVC and IDE. The combination of MVC frameworks with IDE differs with different factors.

The research goal is to find the best combination of MVC framework with particular relational database management system (RDBMS). This research will help the software development firms in choosing the best combination of MVC and RDBMS for developing web based applications.

A brief describing of MVC and different MVC frameworks are described here:

1.1. MVC Architecture

The model view controller (MVC) is a design pattern that separates control logic, user interface, and data access logic into three tiers, resulting in a more adaptable, scalable, maintainable, and reusable application. The MVC architecture divides the system into three parts: the model, which represents domain knowledge; the view, which represents the user interface; and the control, which governs how views are updated. This design pattern is particularly suited for developing web applications with a focus on throughput and response time.

1.2. PHP MVC Framework

The PHP frameworks mentioned are built upon the Model, View, and Controller (MVC) design pattern, which is a tried-and-true approach for developing modular, organized applications. The MVC design pattern divides the application into distinct layers that can be examined and even developed independently, making it a powerful tool for software design. By separating the models and views, MVC reduces the intricacy of architectural design, thereby increasing the flexibility and reusability of the code [1, 2].

1.3. PHP Performance Benchmarks

Performance benchmarks that focus on CRUD (Create, Read, Update, and Delete) operations can be a valuable resource for identifying performance bottlenecks in PHP applications that interact with databases. These benchmarks can aid developers in optimizing their code and enhancing the performance of their applications. Nevertheless, it's crucial to acknowledge that such benchmarks may not entirely reflect the real-world performance of an application, as the size and complexity of the database can impact the results. Therefore, it is recommended to employ benchmarks as a single tool in a comprehensive performance optimization strategy.

1.4. CodeIgniter

CodeIgniter is among the early PHP frameworks, with its initial version released in early 2006. Rick Ellis, a musician turned programmer, is the mastermind behind CodeIgniter, which he developed because he was dissatisfied with the PHP frameworks available at that time. Ellis was particularly frustrated with poor documentation, steep learning curves, complicated deployment, and the need for terminal commands. Developers can use a compressed package that contains the framework's file structure to begin using it. Upon using the framework for the first time, developers would notice recognizable techniques such as the MVC pattern and C-like object orientation [3].

1.5. Laravel

Laravel architecture is a multi-layered approach used for web applications development. In the multi-tier structure, the database is not directly accessible by the clients. Instead, the client connects to the server dynamically in real-time and interactive mode. CGI, ISAPI, NSAPI, are used to create server application to achieve this functionality [4]. Laravel framework and a general data manipulation persistence framework is used to develop a layered structure of the web application. The framework is extended with Laravel's core components and labels, and integrated with the generic data manipulation persistence framework. Data sets' structure can be defined statically using data set definition components, which can also define the mapping relationship between data sets, data queries, and stored procedures [4].

1.6. Phalcon

The decision to choose the Phalcon framework for this project was based on its open-source nature. What sets Phalcon apart from other PHP frameworks is that it is written in C programming language as a PHP extension. Developed by the Phalcon Team, it follows the MVC principles and is distributed under the BSD license, specifically the "New BSD License". The Phalcon framework boasts several characteristics, including that all components are written in C programming language, it has different versions for popular operating systems such as Linux, Windows, and Mac, and it offers high performance with low server resource usage. In fact, Phalcon has been proven to be one of the fastest PHP frameworks in performance tests. Additionally, Phalcon uses ORM technologies implemented in C

language to interact with databases, making it a reliable and efficient choice for database management [5, 6].

1.7. Database

In today's technology-driven world, databases play a pivotal role. A database refers to a software system that helps organize structured data, information, and knowledge, usually stored and processed electronically in a computer system. Generally, a database is managed by a database management system (DBMS). Today, there are several types of databases available in the market, including Relational databases, Object-oriented databases, Distributed databases, NoSQL databases, Graph databases, Cloud databases, multi-model databases, Document/JSON databases, and Self-driving databases [7].

1.8. Relational Database

A type of database that organizes and allows access to interconnected data points is known as a relational database. It is based on the relational model, which presents data in tables and serves as the basis for relational databases. Relational database transactions are characterized by four key features known as ACID: atomicity, consistency, isolation, and durability, which ensure that database transactions are reliable, secure, and complete.

1.9. Basic Operation

A relational database system performs fundamental operations such as inserting tuples into a database table, updating tuples in a database table, selecting tuples to read from a database table, and deleting tuples from a database table.

1.10. MySQL

MySQL is an open-source relational database management system (RDBMS). This system is currently used widely for managing data in a scalable, reliable, and high-performance manner. Many web applications, including popular ones such as Facebook, Twitter, and YouTube, use MySQL as their primary RDBMS. MySQL consists of two main components: a database server for storing and managing data, and a client program for connecting to the server and performing operations on the data. The client program can be either a command-line tool or a graphical user interface (GUI) application [7], such as MySQL Workbench. MySQL uses the standard Structured Query Language (SQL) to manage data, allowing users to perform various operations, such as creating, reading, updating, and deleting data. In addition, MySQL supports advanced features, such as transactions, stored procedures, triggers, and views, which make it more powerful and flexible.

1.11. PostgreSQL

PostgreSQL is an open-source relational database management system (RDBMS) that is highly advanced, scalable, and reliable, making it a popular choice for many enterprise-level applications [8]. It is known for its robustness, extensibility, and support for advanced features. Like MySQL, PostgreSQL also uses Structured Query Language (SQL) to manage data, but it provides additional support for various programming languages, such as Python, Java, and C++, making it a versatile tool for developers. PostgreSQL supports advanced features such as transactions, stored procedures, triggers, and views, which make it more flexible and powerful. PostgreSQL is highly scalable and can handle large amounts of data and users, making it suitable for small and large-scale applications. It also provides support for horizontal scaling through sharding, which enables users to split data across multiple nodes to improve performance [9].

2. Related Works

The growing demand for efficient, reliable, maintainable, and scalable web development has made PHP frameworks an indispensable tool for the developers in designing web pages. PHP frameworks are designed to facilitate the web developer to create the pages with simplicity. Hence, the popularity is increasing of such frameworks due to their ability to expedite development and reduce time, resulting in robust, maintainable code for the final web applications. While there are numerous PHP frameworks available today, each with its own unique advantages, selecting the best one can be challenging, requiring a solid understanding of the different frameworks, along with a method of evaluation and performance testing [1,10]. A number of research was done to identify the performance of different PHP frameworks with the relational databases were done.

Laaziri, et. al. (2019) [1] In order to evaluate the performance of Laravel, Symfony, and CodeIgniter, a benchmarking analysis was conducted based on several criteria including request per second, memory usage, response time, and the number of files required on each MVC. To assess the performance of each framework, a web page design was created and Apache Benchmark was used as a testing tool. This allowed for a thorough evaluation of the three frameworks.

Prokofyeva, N., & Boltunova, V. (2017) [11] compares and provides an overview of several popular PHP programming frameworks, including CakePHP2, CodeIgniter, Symfony2, Yii, and Phalcon PHP, using various criteria. From the data collected, two frameworks, Symfony2 and Phalcon PHP, were selected for deeper analysis based on their popularity. The architecture and main features of these two frameworks were discussed thoroughly. A performance test

was conducted on both frameworks. The test was performed using Apache tools. Based on the results, recommendations were made for web developers to choose right framework for their projects.

The rapidly expanding landscape of Information Systems has introduced a plethora of exciting technological solutions. However, it is not advisable to adopt a technology without considering its impact on the existing information system and user expectations. Instead, it is recommended to identify and implement the technological solutions that align with the Information Systems strategy. PHP Frameworks are one of the emerging methods and design tools that offer new possibilities for information system enrichment. This study compares the two most popular PHP frameworks, Laravel and Symfony, using a comprehensive seven-dimensional model. The study helps the developers to choose right PHP framework.

Laaziri, et. al. [12] showed a result that assists developers of information systems to select the right process between PHP frameworks. Here the study was specifically between Symfony PHP and Laravel PHP. The authors present a comprehensive model to incorporate multi dimensions. The dimensions are the Features, System Requirements, Multilingual Support, and Technical Architecture, with this model the developers can make more informed decisions when selecting a PHP framework for their project.

Frameworks are a crucial component for development projects, regardless of their size. PHP is the most widely used scripting language among developers, resulting in a plethora of PHP frameworks available. [13,14] However, not all frameworks are created equal, and selecting the right one is challenging. In this study it was propose a comprehensive model for evaluating and comparing the main PHP frameworks. The model consists of several criteria, and they are speed, strategy, technical adaptability, intrinsic durability, industrialized solution and technical architecture. The ultimate research output of this model is to allow developers to select the best framework suit for project.

Samra, J. (2015) [3,15] assess the performance of four widely used PHP frameworks - Laravel, CodeIgniter, Phalcon, and Symfony - in comparison to plain PHP. The motivation was the lack of comprehensive comparison tests between these popular PHP frameworks. It discussed the quality attributes i.e. speed, performance. In this study the performance of the frameworks was evaluated through five equivalent PHP functionality. results of these experiments are analyzed and interpreted. Out of these, the finding shows that the targeted frameworks perform differently from each other and from plain PHP.

Selecting the right PHP framework for a web application environment significantly impacts the project's cost, time, and success. However, with numerous frameworks available, conducting a multi-criteria comparison can be challenging. This paper proposes a multi-criteria approach for selecting a PHP framework and to compare selected frameworks for designing and executing web application projects. Choosing the appropriate comparison method and criteria is crucial for conducting comprehensive research and obtaining clear results. The article discusses and justifies the chosen comparison method, criteria, and weights.

This article presents the Expansible Communication Platform for e-University (XCPU), a real web application project aimed at enhancing decision making among teachers and students by using communication between university authorities. The project's requirements and unique features are described in detail. Furthermore, the article outlines the comprehensive process of selecting an appropriate PHP framework for the XCPU project, including the algorithm, calculations, and resulting framework recommendations based on a detailed case study.

3. Methodology

In this paper our approach was to compare different combinations among MVC's and RDBMS's in round robin fashion. The comparison of MVC frameworks was done on some basic operations with relational databases. This approach is used by web-based application software developers. We developed a model that uses four basic operations of relational databases (insert, update, select & delete). A big dataset was used to find the performance and reliability accurately.

3.1. Insert Operation

One million records insert into Table (testdata) in MySQL and PostgreSQL database according to insertoperation(DB) Algorithm (Algorithm 1) and calculate the mean execution time of every ten-thousand data insertion.

Algorithm 1 insertoperation(DB)

1. **for** i=1 to 100 step 1 **do**
2. **for** j=1 to 10000 step 1 **do**
3. Random Generate Data: D^{ij}
4. D^{ij} Insert into DB
5. **end for**
6. Calculation execution time: T^i
7. **end for**
8. return T

3.2. Update Operation

One million records update of Table (testdata) in MySQL and PostgreSQL database according to *updateoperation* (DB) Algorithm (Algorithm 2) and calculate the mean execution time of every ten-thousand data update.

Algorithm 2 updateoperation(DB)

1. **for** i=1 to 100 step 1 **do**
2. **for** j=1 to 10000 step 1 **do**
3. Random Generate Data: D^{ij}
4. D^{ij} Update into DB
5. **end for**
6. Calculation execution time: T^i
7. **end for**
8. return T

3.3. Select Operation

One million query operation from Table (testdata) in MySQL and PostgreSQL database according to *readoperation* (DB) Algorithm (Algorithm 3) and calculate the mean execution time of every ten-thousand query.

Algorithm 3 readoperation(DB)

1. **for** i=1 to 100 step 1 **do**
2. **for** j=1 to 10000 step 1 **do**
3. Random Generate Data: D^{ij}
4. D^{ij} Read from DB
5. **end for**
6. Calculation execution time: T^i
7. **end for**
8. return T

3.4. Delete Operation

One million delete operation from Table (testdata) in MySQL and PostgreSQL database according to *deleteoperation*(DB) Algorithm (Algorithm 4) and calculate the mean execution time of every ten-thousand delete operation.

Algorithm 4 delete operation(DB)

1. **for** i=1 to 100 step 1 **do**
2. **for** j=1 to 10000 step 1 **do**
3. Random Generate Data: D^{ij}
4. D^{ij} Delete from DB
5. **end for**
6. Calculation execution time: T^i
7. **end for**
8. return T

Table 1. Software specification

SLNO	Device Name	Specification
01	Operating System	Ubuntu 20.04.4 LTS, 64-bit
02	PHP	V 8.0
03	Laravel	V8.0
04	CodeIgniter	V3.1.0
05	Phalcon	V4.0.6
06	Web Server	Apache 2.4.54
07	MySQL Database	V 8.0
08	PostgreSQL Database	V 10.20

3.5. Implementation

Our proposed model has been implemented in programming language by using PHP & MVC Framework Laravel, CodeIgniter, Phalcon (Table 1) and using relational database system MySQL, PostgreSQL with database schema shown in Table 3. Our proposed model requires and certain minimum hardware. Though we have used much higher configured

computers for our purpose. Hardware used for our experiments are shown in Table 2. Data analysis of execution time by Python-programming language.

Table 2. Hardware specification

SLNO	Device Name	Specification
01	Processor	Intel Core i5
02	Primary Memory	DDR3 2x8GB, Bus Speed 1600MHz
03	Storage	120GB SSD

Table 3. Database table schema (table name: testdata)

SI No	Column Name	Data Type
01	id_no	Long integer Primary Key
02	data_name	Char (100)
03	data_hash	Char (64)
04	entry_date	Long integer

4. Result and Performance Analysis

Our aim was to find the best combination of PHP framework with relational databases to identify the best combination. Here we have analyzed graphically as well shown in tables to show performance. So that we can compare easily.

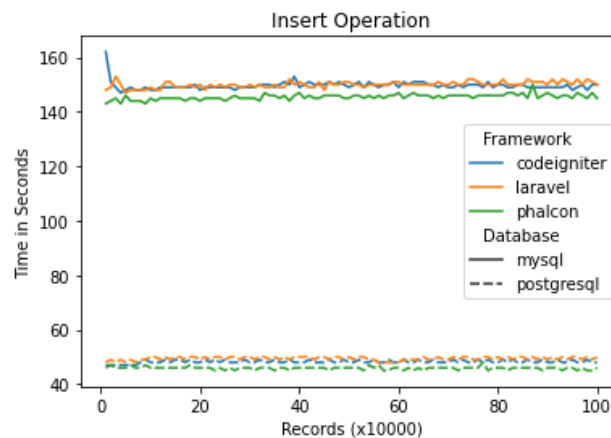


Fig.1. Insert operation of MVC framework

The descriptive analysis of insert, update, select & delete operation is shown in Table 4, 5, and 6 & 7. There were the mean values of insert operation in MySQL database of Codeigniter, Laravel, Phalcon were 149.64, 149.99, 145.48 and PostgreSQL database's 48.259, 49.39, 45.87 respectively and standard deviation were 1.560, 1.124, 1.020, 0.575, 0.650, 0.544 and variance 0.242, 0.179, 0.040, 0.109, 0.248, 0.233 respectively (Table 4).

Table 4. Descriptive analysis of insert operation

	MySQL			PostgreSQL		
	Code igniter	Laravel	Phalcon	Code igniter	Laravel	Phalcon
min	147.000	147.000	143.000	47.000	48.000	45.000
mean	149.640	149.990	145.480	48.250	49.390	45.870
max	162.000	153.000	150.000	49.000	50.000	48.000
std	1.560	1.124	1.020	0.575	0.650	0.544
var	0.242	0.179	0.040	0.109	0.248	0.233

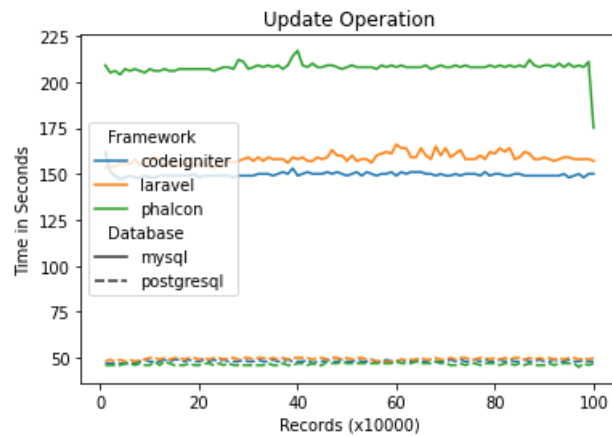


Fig.2. Update Operation of MVC framework

Table 5. Descriptive analysis of update operation

	MySQL			PostgreSQL		
	Code igniter	Laravel	Phalcon	Code igniter	Laravel	Phalcon
min	147.000	153.000	175.000	47.000	48.000	45.000
mean	149.640	158.390	207.820	48.240	49.390	46.640
max	162.000	166.000	217.000	49.000	50.000	48.000
std	1.560	2.756	3.724	0.588	0.650	0.628
var	2.435	7.594	13.866	0.346	0.422	0.394

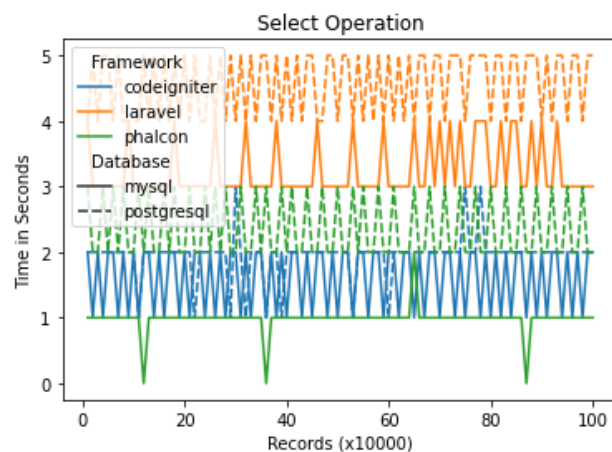


Fig.3. Select operation of MVC framework

Table 6. Descriptive analysis of select operation

	MySQL			PostgreSQL		
	Code igniter	Laravel	Phalcon	Code igniter	Laravel	Phalcon
min	1.000	3.000	0.000	1.000	4.000	2.000
mean	1.600	3.230	0.980	1.950	4.570	2.360
max	2.000	4.000	2.000	3.000	5.000	3.000
std	0.492	0.423	0.200	0.330	0.498	0.482
var	0.242	0.179	0.040	0.109	0.248	0.233

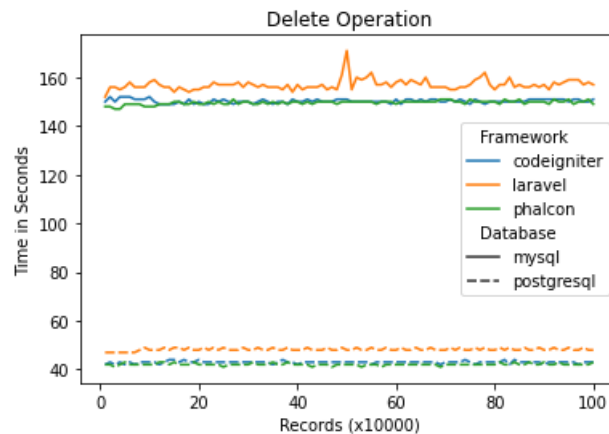


Fig.4. Delete operation of MVC framework

Table 7. Descriptive analysis of delete operation

	MySQL			PostgreSQL		
	Code igniter	Laravel	Phalcon	Code igniter	Laravel	Phalcon
min	149.000	152.000	147.000	42.000	47.000	41.000
mean	150.270	156.990	149.630	42.950	48.250	42.070
max	152.000	171.000	151.000	44.000	49.000	43.000
std	0.790	2.213	0.812	0.458	0.575	0.455
var	0.623	4.899	0.660	0.210	0.331	0.207

5. Conclusions

In the present study shown the basic operation (insert, update, select & delete) of one million data in MySQL & PostgreSQL Database. We demonstrated and statistical analyses in Codeigniter, Laravel, Phalcon MVC frameworks. There is a better performance Phalcon MVC framework in PostgreSQL Relational Database rather than other MVC frameworks.

References

- [1] Laaziri M, Benmoussa K, Khouliji S, Kerkeb ML, "A Comparative study of PHP frameworks performance", *Procedia Manufacturing*, Vol. 32, pp. 864-871, 2019. DOI: 10.1016/j.promfg.2019.02.295
- [2] Das R, Saikia LP, "Comparison of procedural php with codeigniter and laravel framework", *International Journal of Current Trends in Engineering & Research*. Vol. 2, No. 6 pp. 42-48, 2016.
- [3] Samra J., "Comparing performance of plain PHP and four of its popular frameworks", *Depaartment of Computer Science, Linnaeus University*, 2015.
- [4] He RY., "Design and implementation of web based on Laravel framework", In *2014 International Conference on Computer Science and Electronic Technology (ICCSET 2014)*, pp. 301-204, 2015. DOI: 10.2991/iccset-14.2015.66
- [5] Prokofyeva N, Boltunova V., "Analysis and practical application of PHP frameworks in development of web information systems", *Procedia Computer Science*, Vol. 104, pp. 51-56, 2017. DOI: 10.1016/j.procs.2017.01.059
- [6] Olanrewaju RF, Islam T, Ali NA. An empirical study of the evolution of PHP MVC framework. In *Advanced Computer and Communication Engineering Technology: Proceedings of the 1st International Conference on Communication and Computer Engineering*, pp. 399-410, 2015. DOI: 10.1007/978-3-319-07674-4_40
- [7] Database. Available at: <https://www.goldenfast.net/blog/apa-itu-database>. Accessed on 10th January, 2023.
- [8] Guy Karlebach, Leigh Carmody, Jagadish Chandrabose Sundaramurthi, Elena Casiraghi, Peter Hansen, Justin Reese, Chris J Mungall, Giorgio Valentini, Peter N. Robinson, "An algorithmic framework for isoform-specific functional analysis", *Biorxiv*, 2022-05. DOI: 10.1101/2022.05.13.491897
- [9] PostgreSQL. Available at: <https://appypie.com/connect/apps/postgresql>. Accessed on 10th January, 2023.
- [10] Prokofyeva N, Boltunova V., "Analysis and practical application of PHP frameworks in development of web information systems", *Procedia Computer Science*, Vol.104, pp. 51-56, 2017. DOI: 10.1016/j.procs.2017.01.059
- [11] Laaziri M, Benmoussa K, Khouliji S, Larbi KM, El Yamami A, "A comparative study of laravel and symfony PHP frameworks", *International Journal of Electrical and Computer Engineering (IJECE)*. Vol. 9, No. 1, pp:704-12, 2019. DOI: 10.11591/ijece.v9i1. pp704-712
- [12] Benmoussa, Khaoula, Majida Laaziri, Samira Khouliji, Mohamed Larbi Kerkeb, and Abir El Yamami. "A new model for the selection of web development frameworks: application to PHP frameworks." *International Journal of Electrical & Computer Engineering*, Vol-9, No. 1, pp. 695-703, 2019. DOI: 10.11591/ijece.v9i1. pp695-703
- [13] Nylén. H., "PHP Framework Performance for Web Development Between Codeigniter and CakePHP", *Bachelor Thesis, School of Computing Blekinge Institute of Technology, Sweden*, 2012.

- [14] Prokofyeva N., Boltunova V., “Analysis and Practical Application of PHP Frameworks in Development of Web Information Systems”, *Procedia Computer Science*, Vol. 104, pp. 51–56, 2016. DOI: 10.1016/j.procs.2017.01.059
- [15] Umm-E-Laila, A. Zahoor, K. Mehboob, S. Natha, “Comparison of open source maturity models”, *Procedia Computer Science*, Vol. 111, pp. 348–354, 2017. DOI:10.1016/j.procs.2017.06.033

Authors’ Profiles



Md. H. Rahman is currently studying as PhD Program in the Department of Computer Science and Engineering, Dhaka University of Engineering & Technology, Gazipur, Bangladesh and working as a Computer Programmer in Jagannath University, Dhaka. He received the M.Sc. degree in Computer Science and Engineering from Dhaka University of Engineering & Technology, Gazipur, Bangladesh.



M. Naderuzzaman is currently working as an Assistant Professor, in the department of Computer Science and Engineering department of Sonargaon University, Dhaka. He did his graduation from MUET, Pakistan, and M.Sc. from DUET, Bangladesh. Currently he is continuing his Ph.D. from DUET, Bangladesh.



Dr. Mohammad A. Kashem is currently working as a professor, in the department of Computer Science and Engineering, DUET, Bangladesh. He has completed his graduation, post graduation and Ph.D. from, State University “Lvivska Polytechnica”, Ukraine, Ukraine.



Bhuiyan M. Salahuddin is currently studying as M.Sc. Program in the Department of Computer Science and Engineering, Jagannath University, Dhaka, Bangladesh. He received the B.Sc. degree in Computer Science and Engineering from The People’s University of Bangladesh.



Dr. Md. Zulfiker Mahmud is an Associate Professor of Computer Science and Engineering Department in Jagannath University, Bangladesh. He received the B.Sc and M.Sc. degree in Computer Science and Engineering from Islamic University Kushtia, Bangladesh. He has completed his Ph.D from Universiti Kebangsaan Malaysia (UKM), Malaysia. He obtained Excellent thesis award of FKAB UKM in 2018. He has authored or co-authored a number referred journals and conference papers. He has experience as Graduate Research Assistant at the Department of Electrical, Electronic and Systems Engineering, UKM, Malaysia.

How to cite this paper: M. H. Rahman, M. Naderuzzaman, M. A. Kashem, B. M. Salahuddin, Z. Mahmud, "Comparative Study: Performance of MVC Frameworks on RDBMS", *International Journal of Information Technology and Computer Science(IJITCS)*, Vol.16, No.1, pp.26-34, 2024. DOI:10.5815/ijitcs.2024.01.03