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Implementation of Gamification in Data Processing with Statistical Visualization for using Google Cloud for Monitoring Performance and Improvement Evaluation of Personnel at PT. Surveyor Indonesia

Fajri Arvandi[1]*, Pariyadi[2]

[1,2] University of Nurdin Hamzah
fajri42vandi@gmail.com[1], pariyadi.twn@gmail.com[2]*

Abstract

Efficient data management is a crucial requirement for large companies like PT. Surveyor Indonesia to enhance performance and make strategic decisions. This research aims to develop an interactive web-based system with a gamification concept, utilizing technologies such as Laravel, MySQL, and Google Cloud Compute Engine. The system is designed to visualize personnel performance data, provide statistical information, and motivate employees through the implementation of a leveling and points system. By leveraging Google Cloud, the developed system is capable of offering high scalability, flexibility, and ease of access. This research is expected to significantly contribute to the operational data management at PT. Surveyor Indonesia and serve as a model for implementing similar systems for other needs.

Keywords: *Gamification, Google Cloud Compute Engine, Data Visualization, Laravel, Performance Monitoring.*

1. Introduction

1.1. Background

PT Surveyor Indonesia, as a state-owned enterprise (BUMN) engaged in survey, inspection, and consulting services, plays a crucial role in various industrial sectors in Indonesia. In performing its duties, the company manages a vast amount of data related to operational performance, which is used to ensure that the services provided meet established quality standards. However, as the company grows and the volume of data it manages increases, PT Surveyor Indonesia, particularly in the Jambi area, faces challenges in managing data effectively and efficiently.

Suboptimal data management can hinder the company's ability to monitor performance, ultimately impacting strategic decision-making. Therefore, a system is needed that can manage data in a structured manner and visualize it in a way that management can easily understand. There are many ways to create a data processing and visualization system, one of which is gamification.

Gamification is a strategic effort to enhance systems, services, organizations, and activities by creating experiences similar to those obtained when playing games to motivate users. By using the concept of gamification, users will be more interactive and efficient in processing data and viewing data visualizations. In deploying the system, the use of the right platform or hosting will help improve the development and updating processes. In this case, Google Cloud Platform is the primary choice due to its capability to build scalable and flexible systems. Thus, Google Cloud Platform is the right choice for the development and long-term resilience of the system

1.2. Problem Limitations

To ensure that this research can be conducted in a focused and directed manner, the following problem limitations have been established:
System Scope:

1. The developed system will only include visualization and management of general data (biodata), conditions, and performance assessments of personnel at PT. Surveyor Indonesia in the Jambi area.
2. The users of the system will only be personnel of PT. Surveyor Indonesia in the Jambi area.
3. The system output will be an interactive website.
4. The gamification concept applied will be limited to 'Achievements Level or Badges' and 'Squad Profile'.

Technology Used:
1. This system development will use a microservice architecture.
2. The programming language used will be PHP, with the Laravel framework.

System Testing: System testing will be limited to the internal scope of PT Surveyor Indonesia, specifically in the Jambi area.

1.3. Research Objectives

This research aims to achieve several main objectives that are expected to make significant contributions to PT. Surveyor Indonesia:
1. Developing an Efficient Data Management System: Designing and implementing a system capable of managing performance data in a structured and efficient manner, facilitating the monitoring and analysis process.
2. Building a Statistical Visualization Module: Developing a visualization module capable of presenting performance data in the form of informative and easily understandable graphs or dashboards for management, supporting faster and more accurate decision-making.
3. Implementing Gamification Concepts: Applying gamification concepts to the system to make user interaction more engaging and interactive. It is hoped that personnel will be motivated to improve their performance with attractive personnel statistics.
4. Utilizing Google Cloud Platform Technology: Deploying the system using Google Cloud Platform, specifically the Compute Engine service, to enhance the system's flexibility and scalability, allowing PT. Surveyor Indonesia to adjust and develop the system in the future without significant obstacles.

1.4. Research Benefits

This research is expected to provide various benefits for different parties, including:
1. Benefits for PT. Surveyor Indonesia:
   a. Improving efficiency and accuracy in the management and monitoring of personnel performance in the company.
   b. Acquiring a more flexible and scalable system that can be easily adapted to future operational needs.
2. Benefits for Researchers:
   a. Gaining practical experience in the development of microservices-based systems that meet industrial needs.
   b. Enhancing understanding of the application of information technology in data management and statistical visualization, which will be beneficial for future careers.

2. Literature Review

2.1. Data Visualization

Data visualization is a way to present data in a graphical format to make it easier to understand. An effective data visualization should clearly explain the presented data and spark the reader's curiosity. Graph arrangement not only explains the underlying data but also allows the reader to isolate problematic areas (e.g., suboptimal product sales) for further analysis. [4]

2.2. PHP

PHP (Hypertext Preprocessor) is a server-side scripting language processed by the server. PHP is used to create or develop both static and dynamic websites. According to a survey conducted by W3tech.comin December 2020, PHP is used by 79% of websites worldwide due to its large community and comprehensive documentation. [2]

2.3. Laravel

Laravel is a popular PHP framework that offers many features, stable performance, and scalability. Laravel uses the MVC (Model View Controller) structure, where data manipulation processes, controllers, and the user interface are separated. The MVC structure facilitates and speeds up web development with a clear structure and flow. [5]

2.4. MySQL

MySQL is a type of Relational Database Management System that uses basic SQL commands. MySQL also supports integration with other programming languages such as PHP, does not require a large amount of RAM, supports multi-user, has a flexible table structure, and offers various data type. [1]

2.5. Javascript

JavaScript is a programming language that can provide complex features and interactions in a web page. One of the commonly encountered features of JavaScript today is its ability to perform actions without reloading the page. [3]

2.6. Google Cloud Compute Engine

Cloud computing, often referred to as cloud computing, is a computing technique that uses shared computer processing resources, where data is sent to and from computers or other devices based on user requests. [6] The advantages of using cloud computing include scalability, flexibility, and security. Cloud computing scalability includes storage, bandwidth, and other needs that are provided and can be adjusted

according to user requirements, thus saving costs. Cloud computing also offers flexibility, allowing users to access cloud services anywhere and anytime. Most importantly, cloud computing offers security. The characteristics of cloud computing are divided into five: on-demand self-service, broadband network access, resource pooling, rapid elasticity, and measured service. Compute Engine is a virtual infrastructure service that gives users full control over their computing environment. With Compute Engine, users can create, configure, and manage virtual machines according to their needs. This allows users to install and run any software, manage security at the infrastructure level, and adjust network configurations as needed for their applications. [7]

3. Result and Discussion

3.1. Design Analysis

3.1.1. ERD

The application is built using an ERD design as shown below, with a total of 14 main tables and 102 fields.

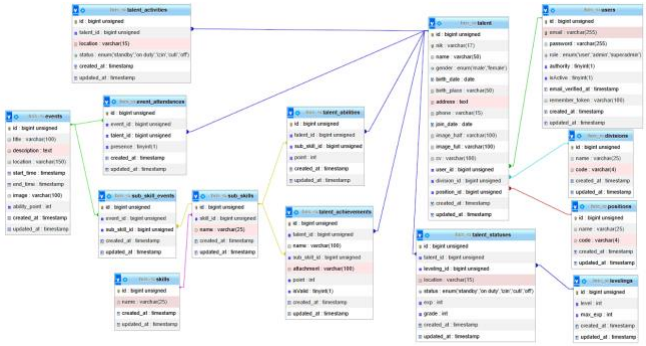

Fig. 1: Example of an image with acceptable resolution

3.1.2 Use Case

The application uses 3 user roles, namely super admin with the highest authority who can perform any actions on the application, then admin, and finally user, which is specifically for company talent or employees.

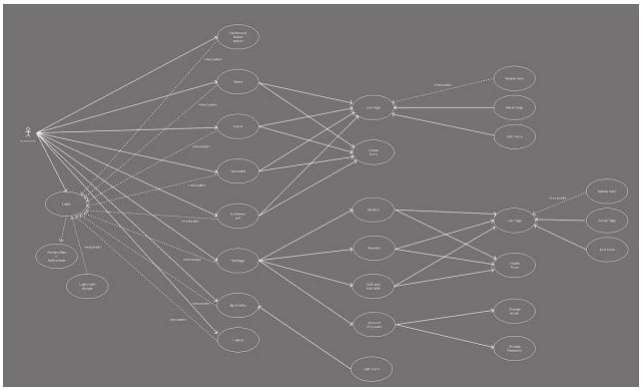

Fig. 2: Super admin Use case

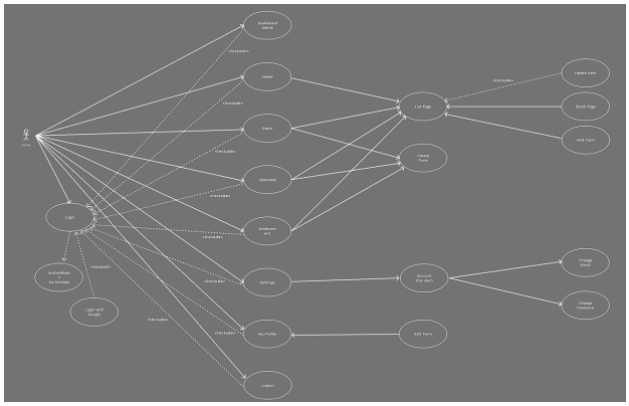

Fig. 3: Admin Use case

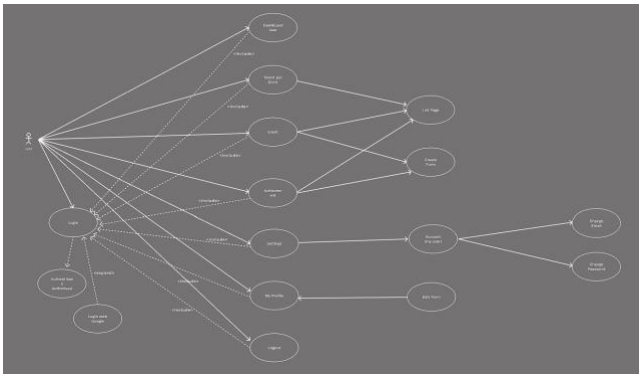

Fig. 4: User Use case

3.1.2. Design UI

Fig. 5: Design Login

Fig. 6: Design Main Menu

Fig. 7: Design Dashboard

Fig. 8: Design User List

3.2. Technologies Used

The technologies used to build this application consist of:

1. PHP, as the programming language:
   PHP is widely used for server-side scripting due to its ease of use, flexibility, and the large community support available. It is an open-source language that is highly efficient for developing web applications with dynamic content. Its ability to seamlessly integrate with HTML and databases makes it a versatile choice for web development.
2. Laravel, as the PHP framework:
   Laravel is a popular PHP framework known for its elegant syntax, robust features, and extensive documentation. It follows the MVC (Model-View-Controller) architecture, which helps in maintaining a clean separation of concerns. Laravel provides built-in tools for tasks like routing, authentication, and caching, which speed up the development process and improve code quality.
3. MySQL, as the database used:
   MySQL is a reliable and widely-used relational database management system (RDBMS). It is known for its high performance, scalability, and ease of use. MySQL supports complex queries and transactions, making it suitable for handling large volumes of data. Additionally, its compatibility with various programming languages, including PHP, enhances its usability in web applications.
4. JavaScript, as the programming language to help manipulate the application interface or user interaction:
   JavaScript is essential for creating interactive and dynamic web pages. It allows developers to implement features like form validation, animations, and asynchronous data loading without refreshing the page. JavaScript enhances the user experience by enabling real-time updates and responsive interactions.
5. TailwindCSS, a CSS framework for styling the application interface:
   TailwindCSS is a utility-first CSS framework that provides a set of predefined classes for designing responsive and modern web interfaces. It allows developers to quickly create consistent and attractive designs without writing custom CSS. TailwindCSS is highly customizable and promotes a mobile-first approach, ensuring the application looks great on all devices.
6. Alpine, an additional library for manipulating the application interface or user interaction:
   Alpine.js is a lightweight JavaScript framework that offers reactive and declarative UI components. It is designed to be easy to use and integrate with existing projects. Alpine.js allows developers to add interactivity to their applications with minimal code, making it a great choice for enhancing user interfaces without the complexity of larger frameworks.
7. Google Cloud Compute Engine, as the application server:
   Google Cloud Compute Engine provides scalable and flexible virtual machines for running applications. It offers high reliability, security, and performance. Using Google Cloud Compute Engine allows for easy scaling of resources based on demand, ensuring the application can handle varying workloads. Additionally, it integrates well with other Google Cloud services, providing a comprehensive ecosystem for application development and deployment.

3.3. Implementation of Leveling and Points System

The leveling system applied in the application consists of 25 levels and exp (experience) at each level increases by +500 with each level increase as shown below:

level	max_exp
1	1000
2	1500
3	2500
4	4000
5	6000
6	8500
7	11500
8	15000
9	19000
10	23500
11	28500
12	34000
13	40000
14	46500
15	53500
16	61000
17	69000
18	77500
19	86500
20	96000
21	106000
22	116500
23	127500
24	139000
25	151000

Fig. 9: Level List

Exp is obtained when talent/employees perform tasks, such as when the update status button on the employee dashboard (user) page is clicked, as shown below:

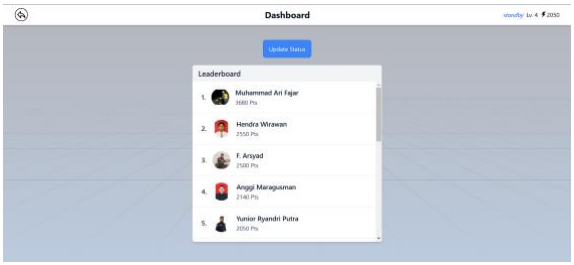

Fig. 10: Dashboard User

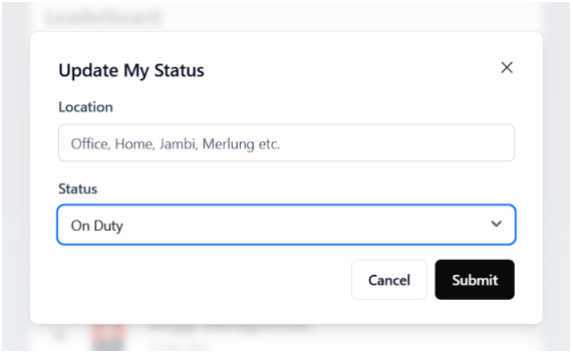

Fig. 11: Modal Update Status

When the update status button is clicked, it will display a status input modal. If the status is set to "On Duty" and the work location is entered and saved, the status will automatically change to "On Duty" and exp will automatically increase by 1000. So, employees will get 1000 exp for leveling up each time they perform tasks.

Points can be obtained in many ways, such as performing tasks (updating status), from created events, from achievements earned, and from internal assessments (QA/QC). This points system is used to rank employees against each other. When employees access the dashboard, they will see the ranking of employees in their division. If the superadmin/admin accesses the dashboard, they will see the overall ranking of employees (all divisions), as shown below:

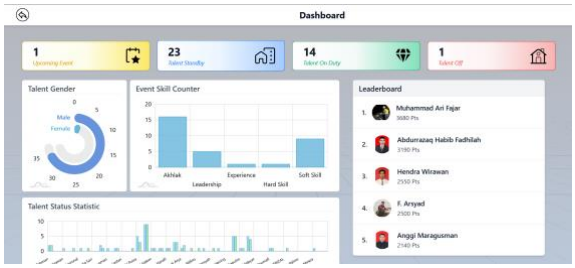

Fig. 12: Dashboard Super Admin and Admin

3.4. Result Implementation

Fig. 13: Login Page

Fig. 14: Main Menu Page

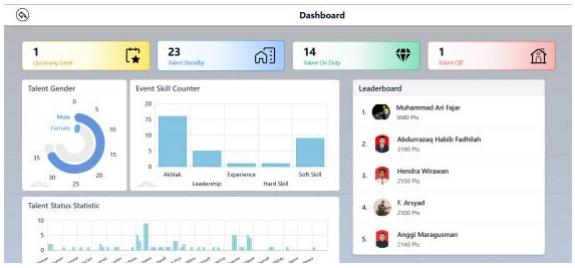

Fig. 15: Dashboard Super admin and Admin Page

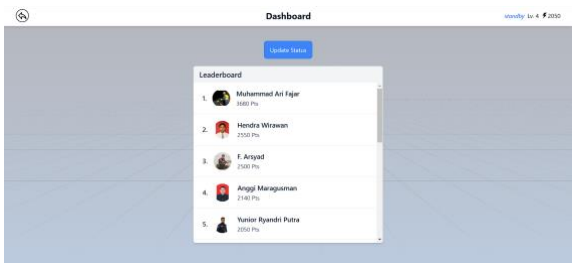

Fig. 16: Dashboard User Page

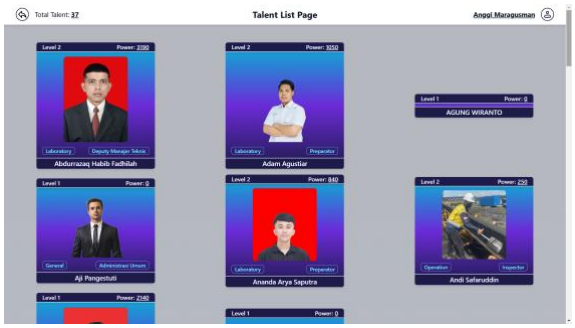

Fig. 17: User List Page

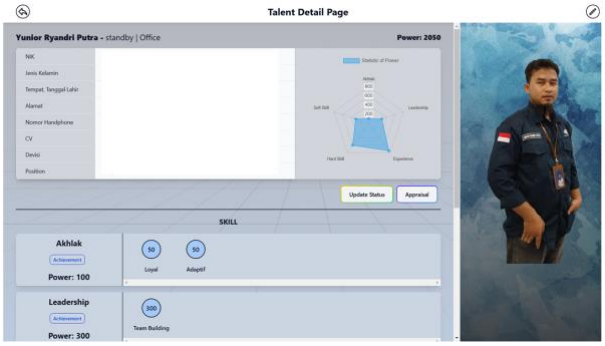

Fig. 18: User Detail Page

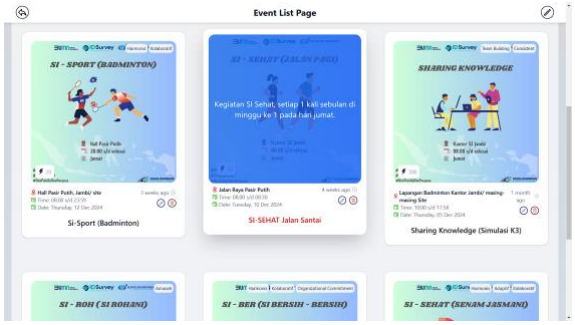

Fig. 18: Event List Page

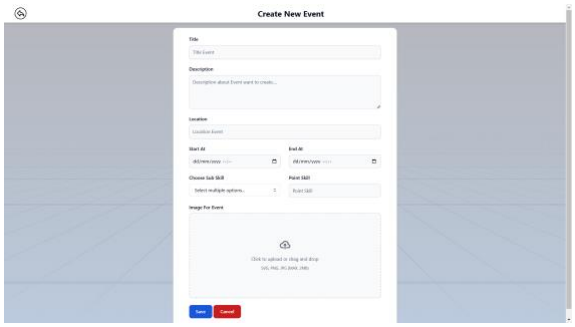

Fig. 18: Create New Event Page

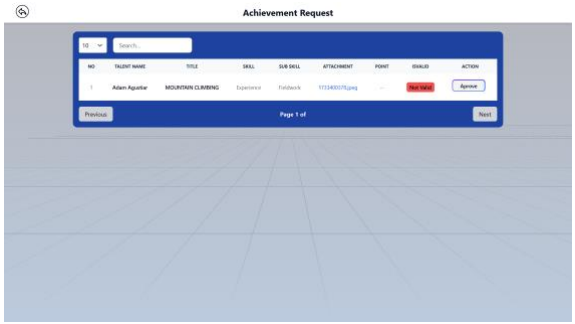

Fig. 18: Achievement Submission Page

4. Conclusion and Suggestions

4.1. Conclusion

This researcher successfully designed and implemented a web-based data management system with statistical visualization using PHP, Laravel, and Google Cloud Compute Engine technologies. The application of gamification concepts, such as a leveling and points system, has been able to increase employee motivation through engaging statistics and internal competition among employees. In addition, the utilization of Google Cloud Compute Engine provides flexibility in server development and management, making the system more scalable and reliable for the long term. Overall, the developed system offers a practical solution for PT. Surveyor Indonesia to efficiently monitor and evaluate personnel performance, particularly in the Jambi area.

4.1. Suggestions

For future development, it is recommended to consider the following:

1. Development of Additional Features: Consider adding automatic notification features to alert employees about the levels or points they have achieved to enhance user engagement.
2. Wider Testing: Conduct system testing in areas other than Jambi to ensure the system's scalability and compatibility in various operational conditions.
3. Performance Analytics: Add predictive analytics modules using AI/ML technology to provide deeper insights into personnel performance and their development potential.
4. Data Security: Since this system is cloud-based and handles sensitive personal data, it is essential to implement additional security protocols such as data encryption, role-based access management, and audit logs.

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