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Analysis and design of a bill notification system using rapid application development

Harsih Rianto
Fakutlas Teknik dan Informatika, Universitas Bina Sarana Informatika, Indonesia

A R T I C L E I N F O

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ABSTRACT

The current billing management system at PT. Media Prima Jaringan is inefficient, leading to service disruptions and customer dissatisfaction. Despite data recording being assisted by a computer system, significant issues persist. Billing delivery to customers is still done manually by printing invoices, resulting in serious service disruptions. Customer complaints often arise due to discrepancies in billing amounts, late payments, and even service disconnections. Besides customer complaints, the company also incurs losses due to dissatisfied customers switching to other providers, resulting in subscription cancellations. Through the development of a billing notification system using the WhatsApp application, it is hoped that the company can expedite customer billing information. In developing the system, systematic stages are required to produce a good quality Information System that can be used by users. The fundamental stages in the System Development Life Cycle (SDLC) include planning, analysis, design, implementation, testing, and maintenance. One of the SDLC development models is Rapid Application Development (RAD). In addition to using the RAD model for system development, the author also utilizes the Unified Modeling Language (UML) as a tool in the design phase. The RAD approach enables the system to be developed within 45 days, with intensive discussions aiding quicker design completion. Upon implementation, company revenue increases, and customer complaints decrease, highlighting the system's effectiveness in improving service delivery and customer satisfaction.

Corresponding Author:

Harsih Rianto,
Fakultas Teknik dan Informatika,
Universitas Bina Sarana Informatika
Jl. Kramat Raya No.98 2, RT.2/RW.9, Kwitang, Kec. Senen, Kota Jakarta Pusat, Daerah Khusus Ibukota Jakarta 10420, Indonesia
Email: harsih.hhr@bsi.ac.id

1. INTRODUCTION

The successful completion of a system development project is contingent upon the high-quality execution of all work scopes within the agreed-upon time frame, adherence to schedules, and cost realization. Effective and efficient time utilization is thus imperative (Arianie & Puspitasari, 2017). Proficiency in utilizing software development methodologies

and selecting supportive project management applications can facilitate companies in documenting and managing projects. Such proficiency can streamline project setup and monitoring by simply relying on project management information systems (Abdurrasyid et al., 2019).

The expected implications of the research in theory and practice are multifaceted. From a theoretical standpoint, the study contributes to the body of knowledge by showcasing the effectiveness of the Rapid Application Development (RAD) method (Aswati et al., 2017; Dwivedi, 2016) and Laravel 9 framework in information system development. It adds to the understanding of how these methodologies can streamline project execution and enhance system quality. Moreover, the research sheds light on the significance of employing appropriate software development methodologies to achieve optimal project outcomes within stipulated timeframes and resource constraints. The study focuses on developing a customer billing notification system to tackle company challenges, following the Software Development Life Cycle (SDLC). SDLC stages encompass planning, analysis, design, implementation, testing, and maintenance. Rapid Application Development (RAD), a model within SDLC, offers shorter development times, typically 60-90 days, compared to the standard 180 days (Aswati et al., 2017; Dwivedi, 2016).

In practice, the research offers actionable insights for organizations, particularly those in the internet service provision sector, such as PT Media Prima Jaringan. By developing a billing notification system using RAD and Laravel 9, the study provides a practical example of how companies can address challenges related to customer billing and data management (Widodo & Purnomo, 2016). It underscores the importance of leveraging innovative technologies to improve operational efficiency (Oktafianto & Lestarningati, 2018), enhance customer satisfaction, and drive revenue growth. Additionally, the research underscores the importance of effective project management and methodology selection in achieving project objectives and delivering value to stakeholders. Alkaf, Saputra, and Purba similarly applied black box testing in their Thesis Management System design, meeting functional testing expectations within the RAD framework (Alkaf et al., 2022). The integration of Laravel and black box testing ensures efficient and effective system development (Binus University, 2016; Irawan et al., 2018).

Regarding the gaps found in previous research, the current work builds upon and enhances existing literature by addressing several key areas. Firstly, it extends the understanding of how RAD and Laravel 9 can be effectively utilized in information system development, particularly in the context of customer billing systems for internet service providers. By providing detailed insights into the implementation of these methodologies, the study fills gaps in previous research that may have lacked practical application or real-world case studies.

Furthermore, the research bridges the gap between theoretical knowledge and practical application by demonstrating how theoretical concepts such as RAD and Laravel 9 can be successfully applied in real-world projects. It offers a comprehensive analysis of the benefits and challenges associated with these methodologies, thus providing valuable guidance for practitioners and organizations seeking to adopt similar approaches in their system development initiatives. Overall, the current work contributes to advancing knowledge in both theory and practice, while also addressing gaps identified in previous research.

2. RESEARCH METHOD

2.1 Research Stages

The stages of research conducted by the author are illustrated in Figure 1. As depicted in Figure 1, the research begins with direct data collection through observation,

interviews, and literature review. In the first stage, the author conducts direct observation and examination of the ongoing process objects, including customer registration, service product recording, customer service ordering, payment processes, service activation, and report generation to support management analysis and decision-making. In the second stage, the author conducts direct interviews with relevant and authorized departments to gather comprehensive and in-depth information related to the implemented billing system. The third stage involves literature review to gather data from books, journal articles, and internet resources as references for the design of the billing notification system.

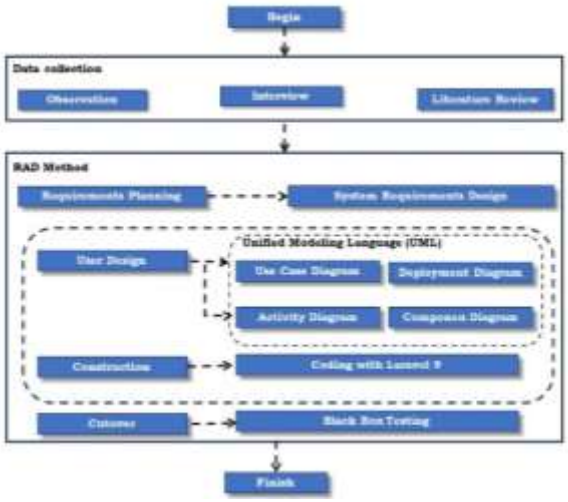

Figure 1. Research Stages

Subsequently, in the implementation stage of the RAD method, several activities are carried out including: a) Requirements Planning, b) User Design, c) Construction, and d) Cutover (Kendall & Kendall, 2006; Whitten & Bentley, 2007). The requirements planning stage involves designing the system requirements that will be used, wherein user interviews are conducted. The second stage is User Design, which involves creating diagram designs using UML and database designs using ERD and LRS. The UML diagrams created include use case diagrams, activity diagrams, deployment diagrams, and component diagrams. The third stage is construction, using the PHP programming language with the implementation of Laravel 9 framework. The fourth stage in the implementation of the RAD method is cutover, where program code is tested using black box testing.

2.2 System Development Method (RAD)

The development of the billing notification system undertaken by the author is implemented through the Rapid Application Development (RAD) method, which is one of the models of the System Development Life Cycle (SDLC) (Aswati et al., 2017; Sasmito et al., 2020). The development of the system using Rapid Application Development (RAD) offers advantages such as shorter development time, increased flexibility, enhanced user involvement, and reduced likelihood of errors (Hidayat & Hati, 2021; Saraswati et al., 2021). The Rapid Application Development (RAD) method can be visualized in Figure 2. In this model, several stages of system development are as follow (Hidayat & Hati, 2021):

a. Requirements Planning.

During this stage, users and authors engage in discussions to investigate and solve existing problems, determining what is needed to create the billing notification system. As this stage marks the initial step towards the success of developing the billing notification system, effective and communicative communication between the author and users is crucial.

b. User Design.

This stage involves creating proposals for designs that meet requirements, adhere to plans, and are expected to address existing issues. In this study, the system design is depicted using Unified Modeling Language (UML) tools.

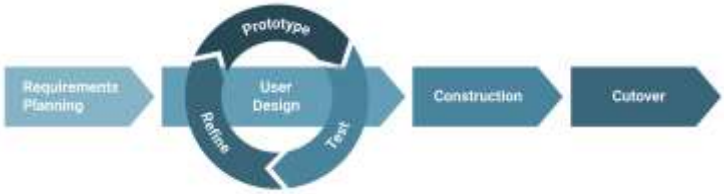

Figure 2. Rapid Application Development (RAD) Model

c. Construction

This stage marks the beginning of building the planned system. It starts with creating program code, or coding, to transform the previously designed system into an application ready for use. In developing the program code, the author utilizes the PHP programming language and Laravel 9 framework.

d. Cutover

This stage involves testing the entire built system. All system components need thorough testing using Black Box Testing to minimize the risk of system defects. Black Box Testing is a software testing technique focusing on the functional specifications of the developed software (Destiningrum & Adrian, 2017; D. Naista, 2017; David Naista, 2016; Oktafianto & Lestarningati, 2018).

The utilization of RAD method in system development presents several advantages as follows (Aryanti et al., 2021): (a) Cost savings in development compared to purchasing a new system. (b) Simplified program delivery process, as it predominantly involves scripting. (c) Enhanced observability due to the prototype model, enabling users to better understand the system being developed. (d) Increased flexibility as developers can simultaneously redesign processes. (e) Ability to minimize errors through the use of supportive tools (Case tools).

However, there are disadvantages to using the RAD method as follows (Aryanti et al., 2021): (a) Incurs additional costs for acquiring system development equipment such as software and hardware. (b) Difficulty in measuring the performance progress of the system development process. (c) Errors may occur due to the lack of meticulousness in employing formal methods in coding. (d) Challenges in implementing the system elsewhere. (e) Provision of facilities that are sometimes unnecessary, where pre-made system components are left unused.

3. RESULTS AND DISCUSSIONS

After completing the research stages and utilizing the RAD system development method, the outcomes of the billing notification system development are depicted in Figures 9 to

16. Several stages are required in the development of the billing notification system using the RAD method as outlined below.

3.1 System Requirement Design (Requirements Planning)

This information system under development includes a login page that serves as user control. There are two distinct users for accessing the billing notification system: Administrator and User. Additionally, there are five access levels, one for the Administrator and four for users with roles as Sales Admin, Finance, Marketing, and Technician.

3.2 User Design

The second stage in the development of this billing notification system involves user design, depicted using Unified Modeling Language (UML), Entity Relationship Diagram (ERD), Logical Record Structure (LRS), and coding. UML serves as a standard specification language in the form of diagrams commonly used to define, write, design, and visualize the blueprint of a software system (Anardani, 2019; Hendy, 2019; Pahlevi et al., 2018).

a. Use Case Diagram

The Use Case Diagram illustrates the expected functionality of a system (Dharwiyanti & Wahono, 2003). It also provides a graphical representation of some or all actors, use cases, and interactions among them that introduce a system. In a Use Case Diagram, detailed explanations of use case usage are not provided; it only gives a brief overview of the relationships among use cases, actors, and the system (Pratama, 2019). As depicted in Figure 3, the Use Case diagram for the Billing Notification System illustrates two actors: Administrator and User, each accessing relevant use cases according to the system's requirements. The use cases depicted in this diagram include login, managing user data, managing service data, managing customer data, managing transactions, accessing reports, and logout.

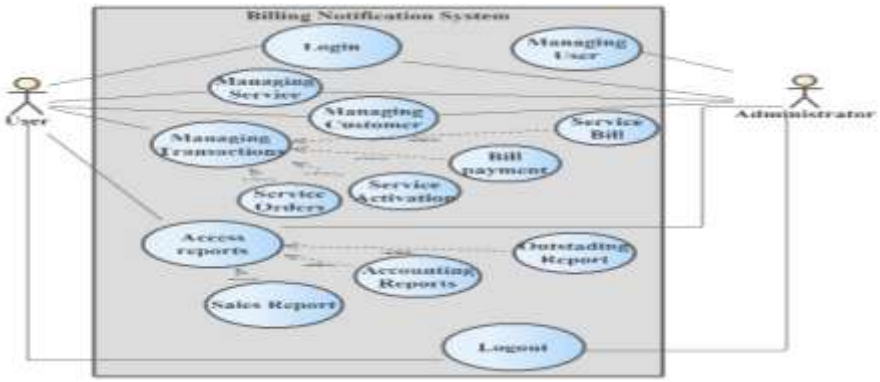

Figure 3. Use Case Diagram

b. Activity Diagram

The Activity Diagram illustrates various activity flows within the designed system, detailing how each flow begins, possible decisions that may occur, and how they conclude (David Naista, 2016; Widodo & Purnomo, 2016). The second stage in user design is the activity diagram, depicting the activities and process flow of the system being developed. The Activity Diagram for Service Billing Payment can be seen in Figure 4. In Figure 4, the Activity Diagram for service billing payment shows the activity starting with the Billing system generating invoices periodically, followed by sending invoice

notification messages to customers. Subsequently, customers who receive invoice notifications will make payments according to the invoice stated in the notification message. Payments can be made through a payment gateway or direct transfer. The system then periodically validates the customer's payment status.

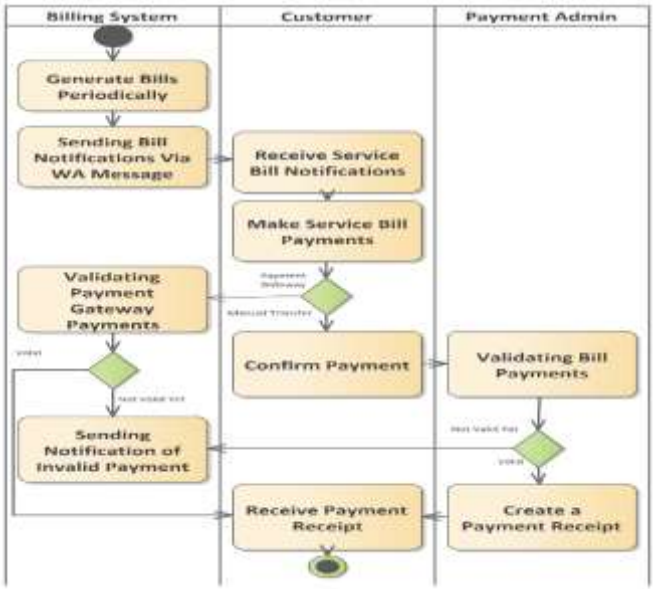

Figure 4. Activity Diagram for Service Registration and (b) Activity Diagram for Bill Payment

c. Deployment Diagram

The Deployment diagram is employed to visualize the relationship between software and hardware (Dharwiyanti & Wahono, 2003; Nur, 2020). As depicted in Figure 5, the Deployment diagram illustrates the layout or physical positioning of system components. The software components operating within the billing notification system are also depicted to observe the infrastructure in use, such as the operating system, database server, and utilized libraries. Additionally, the relationships between components are depicted to facilitate the identification of issues in the future.

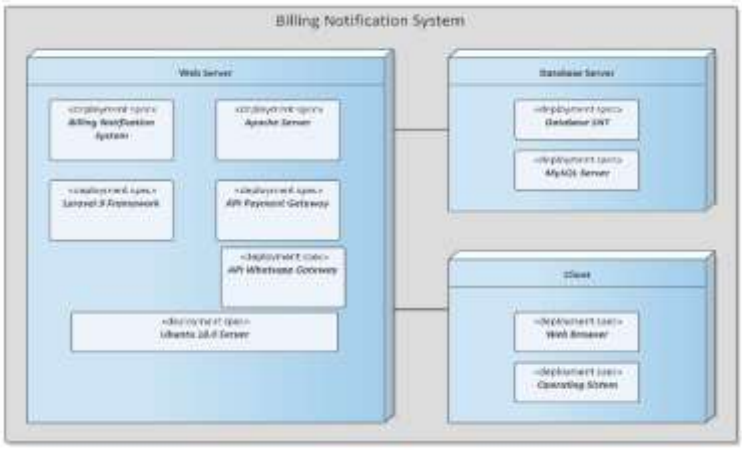

Figure 5. Deployment Diagram of the Billing Notification System

d. Component Diagram

The Component diagram represents the physical aspect of the system corresponding to and providing the realization of a set of interfaces [20]. As depicted in Figure 6, the Component diagram illustrates the organizational structure relationships of software components. This diagram also manifests interfaces in the form of a collection of Services provided by components to be accessed by other components, serving to model interactions among components.

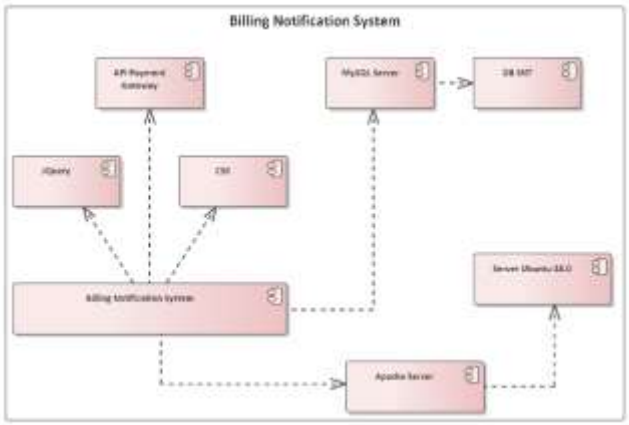

Figure 6. Component Diagram of the Billing Notification System

e. Entity Relationship Diagram (ERD) and Logical Record Structure (LRS)

In designing a database system, the primary stage involves modeling each related entity. Figure 7 represents the Entity Relationship Diagram of the billing notification system. An Entity Relationship Diagram is a conceptual modeling tool used to describe the relationships between data entities in a database. It illustrates relationships among entities based on the fundamental objects of the data (Saryanti, 2018).

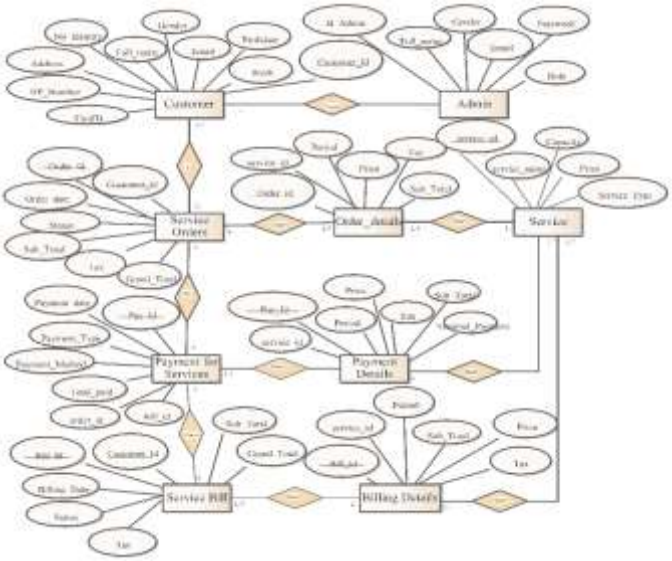

Figure 7. Entity Relationship Diagram of the Billing Notification System

3.3 Construction

a. Login Page

In Figure 8, the login page interface is displayed, where validation occurs after the user enters their email and password. The user login process will be filtered through this login page based on the email registered in the database. If the email and password match the data stored in the database, the logged-in user will be directed to the main dashboard menu as shown in Figure 9.

Figure 8. Login Page

b. Dashboard

In Figure 10, you can see the dashboard page of the billing notification system. On this dashboard page, users can view the number of Customers, the number of service order transactions, the number of payment transactions, and the number of payment transactions. From the display of each data quantity, if the user points to the selected menu, they will be directed to the corresponding page.

Figure 9. Dashboard Page

c. Customer Billing Transaction Page

In Figure 14, you can see the interface for customer billing transactions managed by the notification billing system, accessed by the Finance department for customer billing validation processes.

Figure 10. Billing Transaction Page

d. Customer Payment Transaction Page

The Customer Payment Transaction Page allows users to view and manage all payment transactions made by customers. Here, users can track payments, update payment statuses, and perform other related actions to manage customer payments efficiently.

Figure 11. Customer Payment Page

4. CONCLUSION

Future research could explore the integration of artificial intelligence and machine learning algorithms into the billing notification system to enhance predictive analytics capabilities, enabling proactive identification of billing discrepancies and potential service disruptions. Additionally, investigating the implementation of blockchain technology for secure and transparent transaction recording could further improve data integrity and customer trust.

As for the limitations of this research, one aspect to consider is the scalability of the system to accommodate a growing customer base and increasing transaction volumes. Future studies could focus on optimizing system performance and scalability to ensure seamless operation under heavy loads. Moreover, the generalizability of the findings may be limited to the specific context of PT Media Prima Jaringan, and further research in different organizational settings would provide broader insights into the effectiveness of the billing notification system.

To address these limitations, future research could conduct comparative studies across multiple companies or industries to assess the scalability and effectiveness of the billing notification system in diverse contexts. Additionally, longitudinal studies tracking the system's performance over time would provide valuable insights into its long-term impact on customer satisfaction, revenue generation, and operational efficiency. Finally, exploring user-centric design principles and conducting user experience studies could further refine the system's usability and functionality, ensuring it meets the evolving needs and expectations of users.

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