Vol. 10 No. 1 March 2022
PIKSEL
Penelitian Ilmu Komputer
Sistem Embedded and Logic

Penelitian Ilmu Komputer, Sistem Embedded and Logic
p-ISSN: 2303-3304, e-ISSN: 2620-3553
Vol. 10 (1): 1 – 18 (March 2022)
https://doi.org/10.33558/piksel.v10i1.3183

Design of Web-Based Helpdesk Ticketing System at PT DENSO Indonesia

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Submitted : **10/01/2022**
Revised : **20/01/2022**
Accepted : **18/02/2022**
Published : **26/03/2022**

Abstract

PT DENSO Indonesia currently has a helpdesk ticket system based on IBM Lotus Notes. The system is currently not being used optimally because it has limited features, depends on the platform provider, and the source code is difficult to develop. The company has also taken a policy this year not to continue the subscription process to the platform provider. The purpose of this study is to analyze the current business processes and propose a new system model that is computerized, as needed, reliable, and does not depend on a particular platform. The system was developed based on a website using the Extreme Programming (XP) method as a Software Development Life Cycle (SDLC), Unified Model Language (UML) notation as document design, and calculation of completion rate and time-based efficiency in measuring system effectiveness and efficiency. The website-based helpdesk ticketing system was successfully implemented as a new system model that runs independently and has easy-to-develop source code. The system also has a completion rate of 86% and a time-based efficiency of 0.00924 goal/sec based on a problem reporting scenario with 15 participants.

Keywords*: efficiency, extreme programming, helpdesk, ticket, website.*

1. Introduction

PT DENSO Indonesia is a foreign investment company between Japan and Indonesia that produces automotive components such as air conditioners, spark plugs, compressors, radiators, filters, and other components. Currently, DENSO has three factories located in DKI Jakarta Province and West Java Province with a total of 5,349 employees as of December 11, 2021 (Denso, 2021). In supporting the activities and productivity of the company's business processes, DENSO employees are very intense in using internal applications and computer peripherals in the company environment. However, current internal applications do not always run smoothly and without bugs as well as users do not always understand deeply the features. In addition, the internal applications, computer peripherals in the office

environment, are also not in a good and prime condition because each electronic component has a lifetime for a certain period and is susceptible to damage from various factors.

The IS (Information System) Division is responsible and has full authority for handling internal application problems and computer peripherals in the corporate environment. Employees who use internal applications or computer peripherals who experience problems or problems and want to report these complaints or problems to the IS Division at this time can create tickets containing details of the problems experienced through the use of EDP (Electronic Data Processing) Helpdesk System application based on IBM Lotus Notes. IBM Lotus Notes is a multi-platform software, which means that the application can be run on various operating systems, such as Windows NT, Windows XP, and Windows 7. IBM Lotus Notes is a combination of three technologies, namely Application Development, Document Database, and an integrated Messaging System. Each application in IBM Lotus Notes consists of several basic components including forms, fields, views and folders (Tjiptabudi & Bernardino, 2019). However, in its daily use, the application is not optimally used since it has many limited features that employees rarely use the application and choose other media such as office phones, personal e-mails, or personal social media lines.

The current helpdesk ticket system has limited features such as ticket progress information that is not yet centralized, making it difficult for users to monitor the progress of the problems they complain about, there is no information on the number of tickets being handled by IS Division staff so that problems handling priorities are often disorganized, and communication interaction on each ticket is not yet available so that follow-up for handling problems that require communication must be done on a different and not integrated application.

In 2020, the company has taken a policy not to continue the process of subscribing to the IBM Lotus Notes application which expires in December 2021, making it impossible to develop features that are not yet available in the currently running application and need a new application to replace it. The design of a web-based helpdesk ticket system is intended to replace the current application and the application to be developed must be independent, easy to develop, and provide features that have not been available in previous applications. Based on the description of the problem, it is necessary to develop a web-based helpdesk ticket

system to replace the current system and overcome employee problems related to information technology at PT. DENSO Indonesia. With the implementation of the system, it is expected that the system is easy to develop and can assist employees in conveying information technology problems and getting problem solutions by the IS team quickly and easily.

2.Literatur Review

2.1. Extreme Programming (XP)

XP is an approach or software development model that tries to simplify the various stages in the development process so that it becomes more adaptive and flexible. This method is not just focused on program code but also covers all areas of software development. XP takes an extreme approach to agile development with the aim of minimizing the costs involved in changing software development. As one of the object-oriented approach, XP includes a set of rules and practices that cover four framework activities, namely, planning, design, coding, and testing (Pressman, 2015).

2.2. Unified Modeling Language (UML)

UML is a standard language for designing software to visualize, define, create, and document software. Software architects create UML diagrams to help developers build software. By understanding UML vocabulary (diagram elements and their meanings), developers will find it easier to understand and define a system and explain the system design to others. There are several UML diagrams, namely use case diagrams, use case descriptions, activity diagrams, class diagrams, and sequence diagrams (Pressman, 2015).

2.3. Black Box Testing

Black-box testing, also called behavioral testing or functional testing that focuses on the functional requirements of software. The black-box testing technique makes it possible to obtain a set of input conditions that will fully carry out all the functional requirements for a program. Black-box testing is not an alternative to white-box techniques but a complementary approach that tends to uncover a different class of errors than white-box methods. Black-box testing tries to find errors in the following categories, namely: (1) errors or missing functionality, (2) interface errors, (3) errors in data structures or external database access, (4) behavior or performance errors, and (5) initialization and termination errors.

2.4. Eight Golden Rules

According to (Shneiderman, 2005), eight golden rules principle is a rule that defines interfaces in order to improve implementation in terms of interacting with humans. Some of the points contained in the eight golden rules include the following: (1) Strive for consistency, (2) Seek universal usability, (3) Offer informative feedback, (4) Design dialogs to yield closure, (5) Prevent errors, (6) Permit easy reversal of actions, (7) Keep users in control, and 8) Reduce short-term memory load.

2.5. Effectiveness and Efficiency

Effectiveness is one of the three dimensions in the usability of the ISO 9241-11 (International Organization for Standardization, 2018). Usability in general can be interpreted as the ability of the system to be easy to use and simple to operate. In ISO 9241-11, effectiveness is described by the accuracy and completeness used by users to achieve the specified goals or in other words in the form of attributes that measure how much a tool or a product helps users in completing their tasks.

Efficiency is one of the five components in usability by the Nielsen Model (Nielsen, 2012). In the Nielsen Model efficiency is described by the ability of the system to support users in carrying out their duties in a relatively short and simple time. Efficiency refers to the question: “How quickly can a task be done after learned the design?”. Indicators that can show that a website has met one of the factors of the success of the usability aspect include easy to reach quickly, namely users can obtain information and go to the features they need, as well as complete tasks quickly and easy to navigate, namely users can navigate themselves or user knowledge. own use of the website through easy browsing of the features and content available on the website.

2.6. Previous Research

There is some research related to this study. The first research was conducted by Rico with the title Analysis and Design of IT Information Systems - Helpdesk (Case Study: PT. Lontar Papyrus Pulp & Paper Industry). This research analyzes and designs a system for the IT department that often has difficulty determining and overcoming the scale of its work (emergency, urgent, and normal). Therefore, a web-based application is developed to facilitate all users to report IT problems along with problem priority features in accordance with the provisions provided by management, assignment suggestions and handling implementation schedules for assistant managers which refers to the distribution of workloads for IT

department staff, and provides reports and historical data for evaluation by management in managing and formulating IT equipment maintenance strategies. Application development uses the waterfall method, starting with a needs analysis and ending with system maintenance. As a result, the work priorities that are built can assist the IT department in dealing with problems related to IT equipment, making it easier for management to provide facilities for all employees or users to report IT problems so as to provide convenience in searching, analyzing and minimizing problems (Rico, 2016).

Another research was conducted by Delia Mediana and Andi Irwan Nurhidayat with the title Design and Build a Web-Based Helpdesk (A-Desk) Application Using the Laravel Framework (Case Study at PDAM Surya Sembada Surabaya City). This research builds an application to provide a solution for recording complaints related to problems related to information technology services which are still done manually, complaint data is often lost and damaged, and incoming data must be analyzed first so that the repairs are carried out in accordance with the expertise of the technician. Therefore, an application developer is made that can connect users with technicians in overcoming a problem. The application is built using postgreSQL technology and the Laravel Framework, using the Rapid Application Development (RAD) development method which consists of the bussiness modeling stage to testing and turnover. The results of this study indicate an average number of 60% to 84% in terms of the appearance of the application being attractive, not boring, the features or application menus are easy to understand, the application is in accordance with the needs of the company, the application helps employee performance in problem complaint data management, the system flow can easy to understood and the application becomes easier to monitor the data of complaints that have been submitted (Mediana & Nurhidayat, 2018).

The next research was conducted by Ian Dzillan Malik, Rahmat Fauzi, and Ahmad Musnansyah with the title Design Features of Website-Based Helpdesk Ticketing Application In Section Admin For IT Improvement Activities Using Extreme Programming Method (Case Study: PT Lestari Banten Energi). This research designed an application to provide a solution for reporting problems related to IT equipment from employees in other divisions that were not conveyed properly because the process was still carried out manually using wired telephones or face-

to-face. Therefore, web-based application development is carried out using the Extreme Programming method using the CodeIgniter Framework and MySQL which has a feature to record and store problem report data so that it can assist IT Support in accommodating problems reported by employees. The results of the study show that the application can assist IT Support in accommodating complaints from employees, the method used in development is also suitable for the condition of the development team which is small in number and the scope of the problem is still small (Malik, Fauzi, & Musnansyah, 2020).

3. Research Method

This methodology refers to the Extreme Programming method which has four frameworks, namely planning, design, coding, and test. In the planning phase, several activities are carried out including understanding business processes, identifying problems and analyzing needs, functionality, and desired outputs. The results of the problem identification in this phase generate the idea that a new ticket system is needed that is more effective, efficient, independent, and easy to develop.

The second phase is design. In this phase, the design consists of system modeling, architectural modeling, and database modeling. The system and architecture modeling in this research uses the Unified Modeling Language (UML) which consists of several diagrams including Use Case Diagrams, Use Case Descriptions, Activity Diagrams, Class Diagrams, and Sequence Diagrams while database modeling to describe the relationship between data uses Entity Relationships Diagrams (ERD).

The third phase is coding. This phase implements the design of the system model that has been made into program code with a particular programming language that produces a prototype of the software. This phase uses MySQL as the Database Management System (DBMS) and the PHP programming language combined with HTML, CSS, and Javascript to form the website.

The last phase of this research method is the testing phase. This phase is testing the features and functionality of the entire system that has been built using the black-box testing method which contains testing of the input and output generated by the system. In this phase, a questionnaire analysis was also conducted to test the system hypothesis regarding the level of system effectiveness and efficiency.

System Design

Application development uses SDLC with the Extreme Programming method. The design system utilizes the object-oriented using UML with the use case model, use case diagram, activity diagram, sequence diagram, state diagram, and class diagram. The entity-relationship diagram was created to model the database. The use case model was designed to describe the user requirement, as shown in figure 2. There are three actors and seven use cases in the diagram. Each use case was described in the use case specification documentation. The use case represented the features of the application.

We use activity diagrams to demonstrate the detailed flow for use cases. The first activity diagram is for the login process as shown in figure 3. The user must first login, starting with the user opening the application, after the user has successfully logged in, the next homepage will open. All activity diagrams are generated for each associated use case. The web-based helpdesk ticketing system has three authorizations including user, IS staff, and administrator. Users have the facility to report problems by creating tickets. IS staff have the facility to handle problem reports by receiving and updating ticket status. Administrators have the facility to manage accounts associated with the system. The system has four main features, namely ticket menu, chat menu, search menu, and account menu.

The process of reporting and handling tickets starts when the user successfully log in and join to the homepage. Users can select the ticket menu to start the ticket creation process. The ticket menu has four sub-menus for user authorization and two sub-menus for IS staff authorization. The sub menu for user authorization includes the create sub menu for creating tickets by filling out the problem form, the draft sub menu for viewing the draft list and editing drafts, the on progress sub menu for viewing a list of tickets that are still in progress, and the solved sub menu for viewing the ticket list already handled and waiting for confirmation. The sub menu on the IS staff authorization includes the waiting sub menu to see a list of tickets waiting to be handled, and the on handle sub menu to see a list of tickets being handled.

Furthermore, there is a chat menu which has two sub menus, namely "room chat" which contains a list of conversations that have been carried out and "start chat" to start conversations based on ticket numbers. Each conversation is separated by ticket number. This process is slightly different from the separate

conversation process by account. The new conversation process can be started when a ticket already has a personal in charge. The conversation room will be closed when the ticket is complete.

The next menu is the search menu which only has one sub menu. This menu is for searching and viewing complete information on a ticket with various search parameters such as business unit, equipment id, status, ticket number, requester and pic. The other menu is the account menu. This menu serves to facilitate system users who want to change the login password.

The system evaluation method uses black box testing with the user acceptance test method which contains questions related to system functionality, whether it runs as expected or not. The next evaluation was followed by a questionnaire containing six statements to measure the level of effectiveness and efficiency. Evaluation of the user interface using the eight golden rules by designing the user interface according to the definition of the eight rules.

4. Results and Analysis

The application was built following the XP method.

4.1. System Specification

The application runs in the system which consists of the database server, web server, and browser. Table 1 shows the system specifications needed to run the application.

Table 1. System Specification

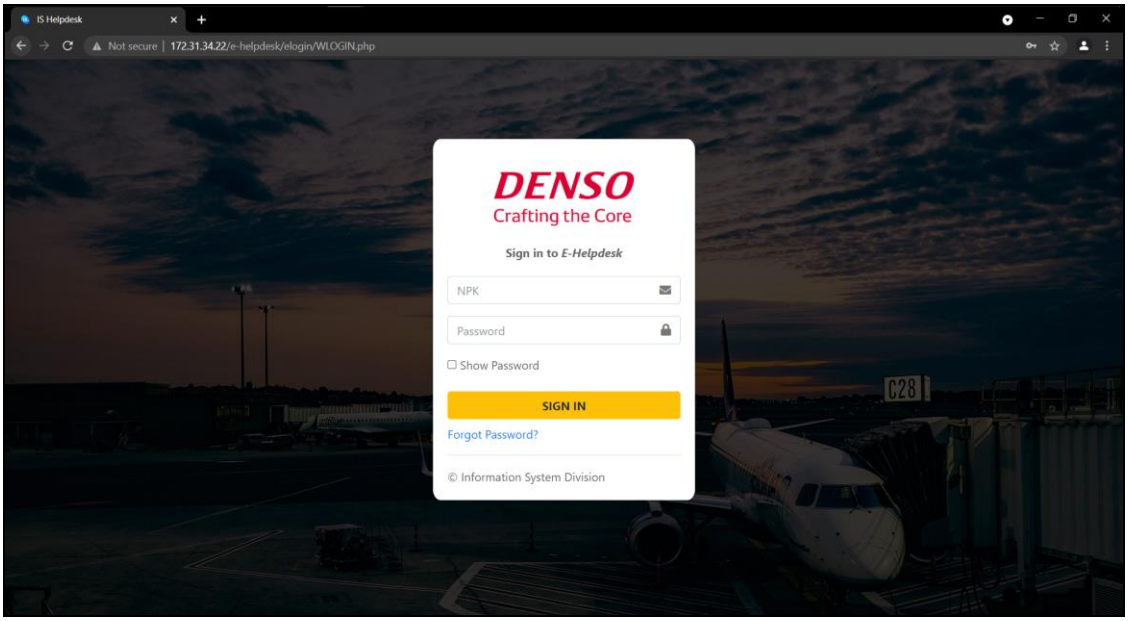
No.	Component	Specification
1	Web Server	Apache version 2.4.10
		PHP version 5.5.28
2	Database Server	MySQL version: 5.6.26
3	Browser	Google Chrome
		Mozilla Firefox
		Microsoft Edge
		IE (Internet Explorer) version 11.0

Source: Research Result

4.2. Application Installation

The installation process is done by placing the entire source code in the web server's htdocs folder and creating tables in the DBMS according to the database design. The website is installed on a web server with a static internet protocol (IP)

address so that the process of accessing the website is done by entering the IP address along with the program name in the web browser URL field.



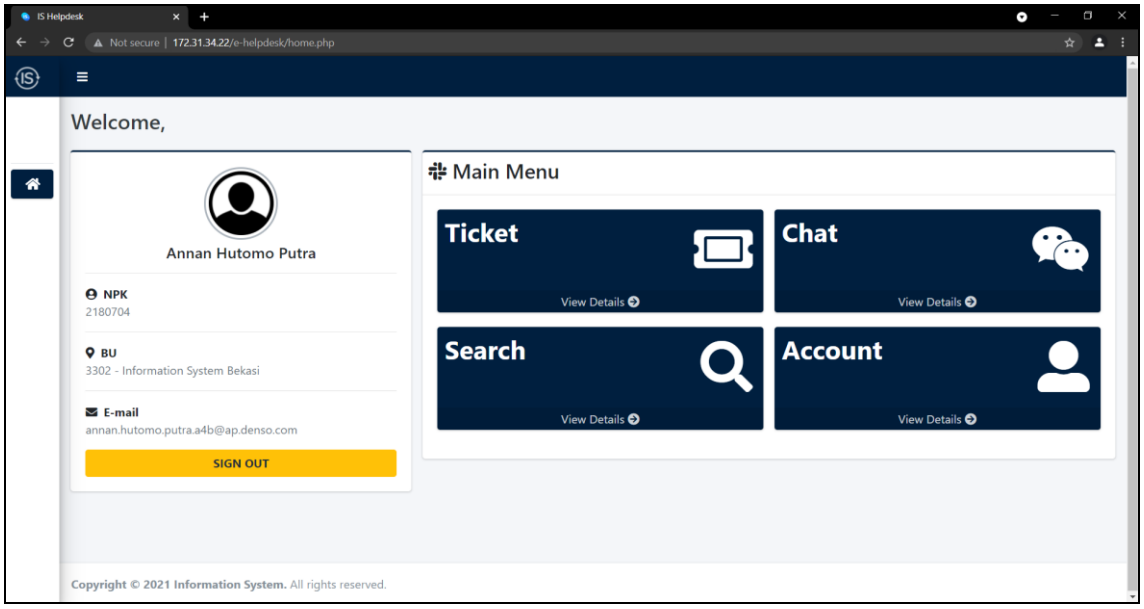
Source: Research Result

Figure 1. Start Page of The Application

Figure 1 shows the start page of the application after it can be accessed by the user.

4.3. Application Flow

The system business process starts when the user has successfully logged in and find the main menu display.



Source: Research Result

Figure 2. Application Main Menu

Figure 2 shows the main menu of the application. The process of reporting and handling tickets begins with the user reporting a problem by creating a ticket by filling out a form via the create ticket sub menu on the ticket menu, then the system will send an email notification to the IS staff. The notification contains a link to view the ticket, if one of the IS staff agrees to handle the ticket, the system will send an email notification to the ticket creator. During the ticket handling process, users and IS staff can use the chat discussion menu to ask more detailed information regarding ticket problems. After the IS staff has finished handling the problem, the IS staff will press the solved button and the system will send an email notification asking the user to confirm that the problem has been resolved. Users can access the system via the link in the notification. If the user feels that the problem with the ticket has been properly resolved, the user will press the complete button as the final process and then the system will send an email notification to the IS staff.

4.4. Evaluation

We performed the eight golden rules (Shneiderman, 2005) to evaluate the interaction of the system to the human behaviors.

Table 2. Evaluation of The System Using Eight Golden Rules

No.	Rules	Results
1	Strive for consistency	The interface of the application tries to maintain consistency both in font style, font color, icons, and overall design. The placement of page buttons, manipulation function buttons, and search inputs in tables is also attempted to be consistent. This can be seen on the On Progress Ticket and Master Account pages.
2	Cater to universal usability	The name of the button that corresponds to its function and use, such as the "Add" button to add data, the "Edit" button to change the data, and the "Delete" button to delete data on the account master page makes it easier for users to make content changes. With the help of search shortcuts the user can also easily search for data.
3	Offer informative feedback	The application provides feedback if the user makes an error when performing an

No.	Rules	Results
		action, such as on the login page, the system will give an error message if the user enters an incorrect combination of NPK and password.
4	Design dialogue to yield closure	The application provides a positive answer if the system user successfully performs an action, such as in the ticket solved process. The application display a message which aims to ensure that the activity carried out by the user is successful.
5	Offer simple error handling	The application keeps system users from making risky mistakes such as displaying a confirmation message when the administrator presses the delete button to delete data on the master account page.
6	Permit easy reversal of actions	When the administrator makes an input error when adding data, the system provides correction facilities by pressing the edit button located in each row in the table as on the account master page.
7	Support internal locus of control	The application provides flexibility in terms of navigation as evidenced by the menu bar that makes it easy to move to the desired page and search, sort, and page facilities on each table to make it easier to find the desired data.
8	Reduce short-term memory load	The application interface is designed in a simple way so that system users can easily remember each layout such as input fields or buttons. The application also uses a concise and clear UI so that users do not have to remember things that are not needed to access the application.

Source: Research Result

Table 2 shows the explanation of eight golden rules; therefore, we can see the interaction between system and users.

Regarding the functionalities test, this research using the black box testing which contains the functionalities to be tested. Each test includes a scenario, description, steps, and the expected results. All the tests are executed and got confirmation from the stakeholder to agree on the results.

The next evaluation is to measure the effectiveness and efficiency of the system by giving the task to 15 participants to report problems by making tickets on the system that has been developed where the efficiency test is also carried out by making tickets using the previous system to compare the efficiency level of the previous system with the new system. The data obtained in the effectiveness and efficiency test are then calculated using the equations that have been determined, the test results at this stage are as follows.

According to (Wahyuningrum, 2021), effectiveness can be calculated by measuring the level of task completion correctly. If the test taker successfully completes the task, he will get a binary value of '1' but if he fails in completing the task, he will get a binary value of '0'. The results of participants who have carried out the effectiveness scenario are shown in the following table.

Table 3. Effectiveness Results

Participant	**Success/Fail**	**n_{ij} (Results)**
1	Success	1
2	Success	1
3	Success	1
4	Success	1
5	Success	1
6	Success	1
7	Success	1
8	Success	1
9	Fail	0
10	Success	1
11	Success	1
12	Success	1
13	Fail	0
14	Success	1
15	Success	1

Source: Research Result

Table 3 shows that 13 participants were able to complete the task successfully and correctly while 2 participants failed to complete the task successfully and correctly in the scenario of reporting problems using the ticket system that had been developed. Then the completion rate can be calculated using formula as follows.

$$\bar{E} = \frac{\sum_{j=1}^{R} \sum_{i=1}^{N} n_{ij}}{RN} \times 100\% \quad (1)$$

Where:

$\bar{E}$ = completion rate

N = number of tasks = 1

R = number of participants = 15

n_{ij} = the result of task i by participant j, will be worth 1 or 0

Therefore:

$$\bar{E} = \frac{(13 \times 1) + (2 \times 0)}{(15 \times 1)} \times 100\%$$

$$= \frac{13}{15} \times 100\%$$

$$= 86\%$$

The test results show that the completion rate of the developed helpdesk ticket system has a score of 86%. Next discussion is about the efficiency category. According to (Wahyuningrum, 2021), efficiency can be measured from the time needed for participants to complete the task successfully. If there are cases of unsuccessful completion of the task scenario, it is measured until the participant gives up on the goal or leaves the system. If the participant is successful, they will get an assignment score of 1, but if the participant fails, then he/she gives up getting a score of 0. In the first stage, the ticket creation scenario is tested using the previous ticket system. The results of participants who have carried out efficiency scenarios using the previous ticket system are shown in Table 4.

Table 4. Efficiency Results of Current System

Participant	t_{ij} (seconds)	n_{ij} (Results)
1	184	1
2	158	1
3	135	1

Participant	t_{ij} (seconds)	n_{ij} (Results)
4	175	1
5	138	1
6	120	1
7	146	1
8	171	1
9	212	1
10	133	1
11	141	1
12	121	1
13	201	1
14	140	1
15	152	1

Source: Research Result

Table 4 shows that 15 participants were able to complete the task with each time that had been achieved and no participant failed to complete the task or exited the system before it was completed. Then using the time-based efficiency equation can be calculated as follows.

$$\overline{P_t} = \frac{\sum_{j=1}^{R} \sum_{i=1}^{N} \frac{n_{ij}}{t_{ij}}}{NR} \quad (2)$$

Where:

$\overline{P_t}$ = time-based efficiency

R = number of participants = 15

n_{ij} = the result of task i by participant j, will be worth 1 or 0

t_{ij} = the time required by participant j in task scenario i.

Therefore:

$$\overline{P_t} = \frac{\frac{1}{184} + \frac{1}{158} + \frac{1}{135} + \frac{1}{175} + \frac{1}{138} + \frac{1}{120} + \frac{1}{146} + \frac{1}{171} + \frac{1}{212} + \frac{1}{133} + \frac{1}{141} + \frac{1}{121} + \frac{1}{201} + \frac{1}{140} + \frac{1}{152}}{1 \; x \; 15}$$

$$= \frac{0{,}0994519}{15}$$

$$= 0{,}00663 \text{ goal/sec}$$

Based on the calculation results obtained a value of 0.00663 goals/sec or in one second participants can complete 0.00663 tasks. Furthermore, the same scenario is carried out using the ticket system that has been developed, while the results of the participants who have carried out the efficiency scenario using the ticket system that has been developed are shown in table 5.

Table 5. Efficiency Results of New System

Participant	t_{ij} (seconds)	n_{ij} (Results)
1	124	1
2	112	1
3	98	1
4	102	1
5	84	1
6	78	1
7	92	1
8	102	1
9	262	0
10	87	1
11	91	1
12	86	1
13	241	0
14	89	1
15	91	1

Source: Research Result

Table 5 shows that 13 participants were able to complete the task with each time that had been achieved while 2 participants failed to complete the task successfully or exited the system before completing the task with each time being the length of time until the participant left the system or gave up. Then using the time-based efficiency equation as in the previous efficiency calculation, the following results are obtained.

$$\bar{P}_t = \frac{\frac{1}{124}+\frac{1}{112}+\frac{1}{98}+\frac{1}{102}+\frac{1}{84}+\frac{1}{78}+\frac{1}{92}+\frac{1}{102}+\frac{0}{262}+\frac{1}{87}+\frac{1}{91}+\frac{1}{86}+\frac{0}{241}+\frac{1}{89}+\frac{1}{91}}{1\ x\ 15}$$

$$= \frac{0{,}13873}{15}$$

$$= 0{,}00924 \text{ goal/sec}$$

Based on the two test results above, the time-based efficiency value in the previous ticket system is 0.00663 goal/sec and the time-based efficiency value in the new ticket system is 0.00924 goal/sec. If the two results are compared, the difference is 0,00261 or participants can complete more tasks with a value of 0.00261 using the new ticketing system in one second.

5. Conclusion

Based on the results of system design and evaluation on a web-based helpdesk ticket system, it can be concluded that: (1) The helpdesk ticket system was successfully designed using the Extreme Programming method with the PHP programming language and MySQL database and tested its performance with the completion rate and time-based efficiency equations, (2) The performance of the helpdesk ticket system has an effectiveness value of 86% using the completion rate equation and an efficiency value of 0.00924 goal/sec using the time-based efficiency equation, (3) The helpdesk ticketing system has been successfully implemented as a new system model in the form of a website and can run independently or not depend on platform providers and has an easy-to-develop source code.

Based on the evaluation of the system, the authors realize that there are still some shortcomings of this system and some suggestions and inputs that can be useful in developing this application to make it better in the future, including: (1) Expanding the scope of this system by developing a mobile-based ticketing system so that the ticket monitoring and tracking process is not limited to desktop use, (2) Integrate this application with social media so that the process of submitting and reporting problems can be done anywhere and saves lead time or the time needed to enter the application, (3) Develop push notification in the discussion function so that new messages can be known by users more quickly, and (4) Implement notifications using WhatsApp which have not been implemented in this study so that problems reported by users can be known more quickly and handled by IS Staff.

Acknowledgements

The authors would like to thank you for the guidance of the Online Learning Computer Science Study Program in Bina Nusantara University so that this research was completed, and the funds provided for publication as the result by Bina Nusantara University.

Author Contributions

Annan proposed the topic; Annan, Eduard and Emny conceived models and designed the system; Eduard analysed the result.

Conflicts of Interest

The author declare no conflict of interest.

References

Denso. (2021). Denso. Retrieved December 11, 2021, from https://www.denso.com/id/en/about-us/at-a-glance/

International Organization for Standardization. (2018). Ergonomics of human-system interaction — Part 11: Usability: Definitions and concepts.

Malik, I. D., Fauzi, R., & Musnansyah, A. (2020). Perancangan Fitur Aplikasi Helpdesk Ticketing Berbasis Website Pada Seksi Admin Untuk Tindakan Perbaikan Perangkat TI Menggunakan Metode Extreme Programming Studi Kasus: PT Lestari Banten Energi, *7*(2), 7298–7304.

Mediana, D., & Nurhidayat, A. I. (2018). Rancang Bangun Aplikasi Helpdesk (A-Desk) Berbasis Web Menggunakan Framework Laravel (Studi Kasus di PDAM Surya Sembada Kota Surabaya). *Journal of Neuroscience*, *8*(2), 75–81. https://doi.org/10.1523/JNEUROSCI.4432-12.2013

Nielsen, J. (2012). Introduction to Usability.

Pressman, R. S. (2015). *Software engineering: a practitioner's approach*. New York: McGraw-Hill Education.

Rico. (2016). Analisis Dan Perancangan Sistem Informasi IT- Helpdesk (Studi Kasus : PT. Lontar Papyrus Pulp & Paper Industry). *Teknologi Informasi*, *10*(2), 296–305.

Shneiderman, B. (2005). *Designing The User Interface: Strategies for Effective Human-Computer Interaction*. *ACM SIGBIO Newsletter* (4th Editio, Vol. 9). Colege Park: Pearson Education, Inc. https://doi.org/10.1145/25065.950626

Tjiptabudi, F. M. H., & Bernardino, R. (2019). Information System Security of Indonesia Terrestrial Border Control. *CommIT (Communication & Information Technology)*, *13*(2), 45–56.

Wahyuningrum, T. (2021). *Buku Referensi Mengukur Usability Perangkat Lunak*. Deepublish. Retrieved from https://books.google.co.id/books?id=Pzk9EAAAQBAJ