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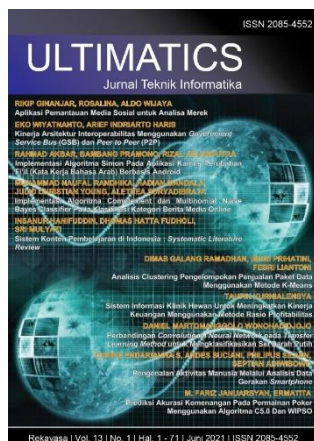
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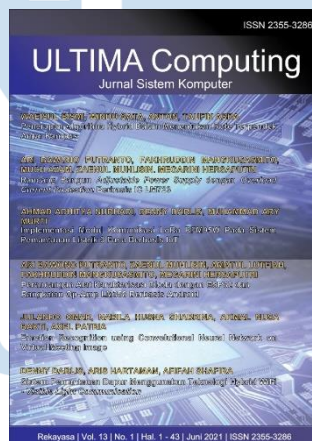
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FOREWORD

Greetings!

Ultima InfoSys : Jurnal Ilmu Sistem Informasi is a Journal of Information Systems which presents scientific research articles in the field of Information Systems, as well as the latest theoretical and practical issues, including database systems, management information systems, system analysis and development, system project management information, programming, mobile information system, and other topics related to Information Systems. ULTIMA InfoSys Journal is published regularly twice a year (June and December) by Faculty of Engineering and Informatics in cooperation with UMN Press.

In this June 2022 edition, ULTIMA InfoSys enters the 1nd Edition of Volume 13. In this edition there are seven scientific papers from researchers, academics and practitioners in the fields covered by Ultima Infosys. Some of the topics raised in this journal are: Implementation of Information System Based on Website as Introduction to Sumbawa's Typical Sakeco Oral Literature, Restaurant Transaction Application Based on Android System, Analysis and Design of an Web-Based Ticketing Service Helpdesk at Food and Packaging Machinery Company, Analysis of Factors Affecting Information System Security Behaviour in Employees at IT Company, Adoption of SNI ISO/IEC 17025:2017 Principles for Laboratory Management Information System Development, Finding Features of Multiple Linear Regression On Currency Exchange Pairs, Aspect-Based Sentiment Analysis on Application Review using Convolutional Neural Network.

On this occasion we would also like to invite the participation of our dear readers, researchers, academics, and practitioners, in the field of Engineering and Informatics, to submit quality scientific papers to: International Journal of New Media Technology (IJNMT), Ultimatics : Jurnal Teknik Informatics, Ultima Infosys: Journal of Information Systems and Ultima Computing: Journal of Computer Systems. Information regarding writing guidelines and templates, as well as other related information can be obtained through the email address ultimainfosys@umn.ac.id and the web page of our Journal here.

Finally, we would like to thank all contributors to this June 2022 Edition of Ultima Infosys. We hope that scientific articles from research in this journal can be useful and contribute to the development of research and science in Indonesia.

June 2022,

Fenina Adline Twince Tobing, S.Kom., M.Kom.
Editor-in-Chief

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Implementation of Information System Based on Website as Introduction to Sumbawa's Typical Sakeco Oral Literature

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Abstract— **Indonesia is an archipelago that is very rich in traditional culture. Traditional culture plays an essential role in attracting tourists. Sakeco is a traditional culture of the Sumbawa tribe. If people do not know the existing culture, it will not be easy to preserve today's culture. Poto Village dance studio still uses books for practice and memorizing types of Sakeco Verse. The books in the studio are very limited because some are stored in the regional library. Information systems have been widely implemented to preserve culture. Hence this research carried out the implementation of information systems to introduce Sakeco oral literature. This research produced a website-based Sakeco oral-literary recognition system with admin features: Posts to add new posts, problem data by creating, recording, updating, deleting, and searching for quiz needs, users to view admin data, and settings to organize posts and website views. While users: do quizzes and see answers as a learning medium, see the History of Sakeco, Sakeco Verse, Sakeco Anorawi, and Sakeco Anosiup, and latest posts to see the latest posts and popular posts to see the most opened posts. Development methods using waterfall, designing methods using Unified Modeling Language, black-box testing get results as expected from various functionality tests. This information system is expected to help the Poto Village dance studio, Sumbawa people and tourists who want to get to know Sumbawa's typical oral literature (Sakeco) and become one of the ways to maintain and preserve the tradition of Sakeco Verse in the Sumbawa area.**

Index Terms— **Black-Box Testing; Information System; Sakeco Oral Literature; Waterfall; Website.**

I. INTRODUCTION

Indonesia is an archipelago rich in traditional culture [1]. The culture embraced has the characteristics of each tribe spread across 34 provinces in Indonesia. Indonesian people still run and preserve traditional culture in everyday life, and this is because the existence and values are still held firmly by the people of Indonesia [2]. Traditional culture also plays an essential role as a source of regional income, especially to attract tourists [3]. This situation makes the government, institutions, or related elements must be able to optimize the preservation of existing culture.

Along with the development of information technology, it has become easy to share data and information with the public, one of which is information about learning and cultural recognition [4]. learning and cultural recognition is the first step to maintain and preserve the existing culture. If the public does not know about the existing culture, it will be a difficult thing in the future for related parties to preserve the existing culture.

Sumbawa Regency is part of Indonesia with a distinctive poem that is chanted with oral known as Sakeco. Sakeco is a traditional art performance of the Sumbawa tribe, also known as Sufi music, because its content contains philosophical meanings [5]. The story illustrates the message of love to God and kindness in living life. In his performance, Sakeco involves two players who play storytellers who must also be able to play tambourine as accompaniment music. Sakeco usually performs at weddings or religious events such as maids, cultural festivals, and welcoming ceremonies. Based on the observations of the art activity community, namely Sanggar Tari (dance studio) Poto Village Moyo Hilir-Sumbawa Subdistrict, where this dance studio does exercises three times a week, but in practice, they still use books to memorize the types of Sakeco Verses. Works that traditional Sumbawa figures have preserved are still in the form of books, and the number is limited. Some books are stored manually in the Sumbawa Regional Library and the art studios of the Sumbawa area, which leads to inefficient processes in the current studio. Therefore, the purpose of this research is the implementation of the Sakeco oral-literary recognition information system to help Poto Village dance studio, indigenous and outside Sumbawa people who want to know and know Sumbawa's typical oral literature (Sakeco) and become one of the ways to maintain and preserve the Sakeco Verse tradition of the Sumbawa area.

Research has been done in the field of information systems, especially the application of cultural recognition aspects, where this information system can accelerate the flow of information received by users, the accuracy and novelty of information, and can be accessed by anyone because it is global [6]. Information systems are a form of software that can convert manual

processes into digital forms by providing time efficiency advantages and ease of solving problems [7]. Website-based information systems have been widely implemented to solve the problem of preserving traditional culture in Indonesia because they can be accessed online through the internet network and can be done anywhere and anytime [8]. A website is a set of domain pages linking web pages with related files and displaying information online. The basis of the website is widely implemented in the creation of information systems due to flexibility, shareability, and having an access policy [9]. Therefore, the information system in this research was built using a website base.

Previous studies conducted by other researchers related to those studied today are as follows: D. Puspita and Y. I. Mukti (2019) Designing and creating a Basemah literary recognition information system using Unified Modeling Language (UML) as a modeling method and Rapid Application Development (RAD) as a development method. Information systems are built to convey cultural recognition to the broader community [10]. This previous article did not use testing methods, and there is no quiz feature as a learning medium. In comparison, the article in this study uses the black box testing method for system testing and has a quiz feature as a learning medium. M. H. Waliyuddin, A. S. Sukamto, and H. Anra (2019) Researching the design of cultural and tourism recognition applications that aim to make it easier for tourists and the wider community to see the beauty of tourists attractions located in Pontianak City. Research in this previous article uses a website base for information systems built by black-box testing methods [11]. This previous research did not describe modeling and did not have quiz features as a learning medium. While in this study uses the Unified Modeling Language (UML) method for modeling and has a quiz feature as a learning medium. A. Maulana, A. Fauzi, U. Radiyah, and F. O. Reynaldi (2020), I. I. Wahyudi, S. Bahri, and P. Handayani (2019) utilize android-based information system technology for the introduction of traditional culture so that it becomes a forum for cultural preservation [12], [13]. The difference with this article is the object being studied and the research site and the basis used. Based on previous research that has been studied related to current research, the strength of this research is the Unified Modeling Language (UML) technique as a designing method, the black-box method for system testing, and information systems will have a quiz feature as a learning medium for visitors.

II. THEORETICAL FRAMEWORK

A. Oral Literature

Oral literature or folklore is part of a culture that grows and develops in society and is passed down through generations orally as a common property [14]. Oral literature mirrors the situation, conditions, and manners of its supporting society.

B. Sakeco

Sakeco is one of the art forms sourced from old or typical verse tau Samawa (Sumbawa community) [5]. Sakeco is a very flexible and dynamic art. Sakeco can be loaded by Lawas Saran, Lawas Tau Loka, Lawas Muda-Mudi, Lawas tode made in the form of speech (narrative stories)

C. Information System

An information system is a collection of interconnected components in collecting, processing, storing, and distributing information to support decision-making and control [15].

D. Website

A website is the entire web page contained in a domain that contains information. A website is usually built on many related web pages [16].

E. Model System Development Life Cycle (SDLC) waterfall

The waterfall is a sequential or sequential software development approach starting from analysis, design, coding, and testing [17].

- The analysis stage is used to document the needs of the software specifications to be used by the user.

- The design stage translates software needs from the needs analysis stage to the design representation.

- The coding stage of implementing the computer program follows the design that has been made at the design stage.

- The test stage is carried out to minimize errors (errors) and ensure the output produced is following the desired.

F. Unified Modeling Language (UML)

UML is a methodology for modeling object-oriented systems development using diagrams and supporting texts [18].

G. Black Box Testing

Testing that focuses on the functional specifications of the software, the tester can define a set of input conditions and test the functional specifications of the program [19].

H. HyperText Markup Language (HTML)

HTML is the markup language of a text document. Markup symbols used by HTML are marked with more minor marks (<) and more significant marks (>) [20].

I. Hypertext Preprocessor (PHP)

PHP is a server-side language that blends with HTML to create dynamic web pages [21].

III. RESEARCH METHOD

The development of information systems using the SDLC waterfall model development method because the user's needs at the beginning are known so that the development process can be structured [22]. The object used as a research place is Sanggar Tari (Studio Dance), located on Jl. Balai Pertemuan RT 002/004 Bekat Poto Village Moyohilir District Sumbawa Regency, West Nusa Tenggara. The problems and manual processes in the dance studio are solved with an information system to be digitized. Lisa Sakeco's literary recognition information system was built on an HTML website with a bootstrap framework and PHP as a programming language for modeling using Unified Modeling Language (UML). The stages of the waterfall development method can be seen in Fig. 1.
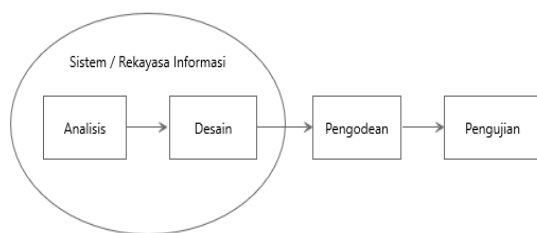
Fig. 1.   Waterfall Development Method

A. Analysis

The Analysis stage is carried out to determine the needs of the entire system to be built by collecting data or related information. The data collection method used is qualitative because it uses some of the data obtained and utilizes previous theories [23]. As for the process carried out: (1) Observation, after directly observing the ongoing process, found a problem of preserving culture and passing it on to the next generation. So it is proposed to build an information system to solve the problem. (2) Interview directly with Mr. Ariffianto, part of the chairman of the studio dance, he revealed: "Sakeco oral literature must be known by the wider community" because the basis used is a website to make it easier for the public to know information. (3) Literature Study is by collecting papers and books through Google Scholar to support research.

B. Design

The design stage is carried out to project the results of the analysis stage. Unified Modeling Language (UML) is applied at the design stage because it supports the development of information systems with the Object-Oriented Programming (OOP) paradigm [24]. UML modeling provides ease of system design so as to minimize errors in making applications [25]. UML can describe the structure of the actors involved, the activities of each actor, the processes and mechanisms of information systems to introduce Sakeco oral literature. In designing the information system in this study, the Use Case Diagram can be seen in Fig. 2.
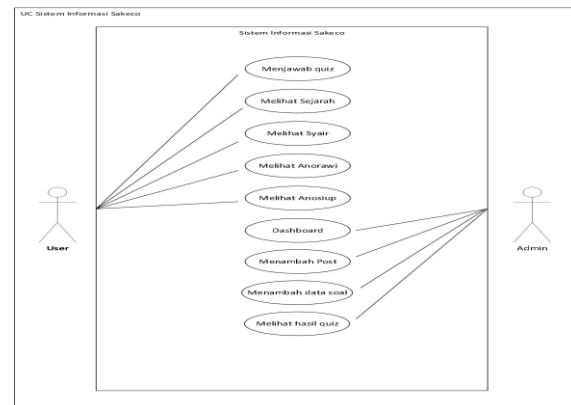
Fig. 2.   Use Case Diagram Sakeco Introduction Information System

Fig. 2 above is a use case diagram for accessing the oral literary recognition information system typical of Sumbawa based on a website describing two actors involved with each other on the information side, namely users and admins. The user's role can see the content of Sakeco Anosiup, Aakeco Anorawi, Sakeco Verse, and answer quizzes on the information system provided by the admin. While the role of the actor admin is to login through the dashboard, add posts, add data questions, and see quiz data that users have filled in.
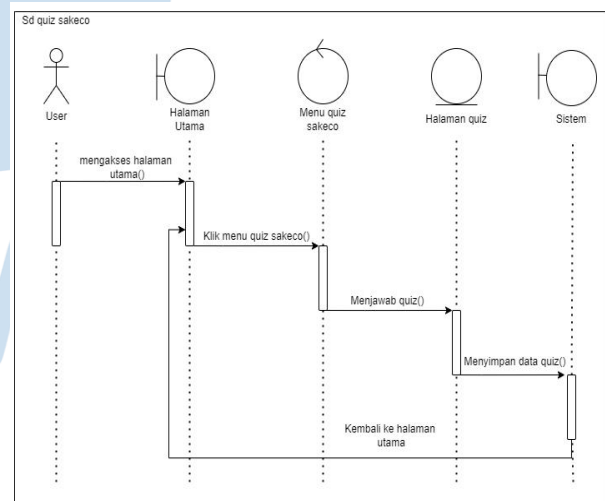
Fig. 3.   Sequence Diagram Quiz

Fig. 3 describes the Sakeco quiz diagram sequence. The process begins when the user opens the information system, and the first one that appears is the main page. After that, users can click on the Sakeco quiz menu on the main page. When the quiz menu is clicked, the view is information about Sakeco quiz questions. If the quiz has been done, the system will save the quiz data, and the user can return to the main menu. the quiz results that have been done by the user can only be seen by the admin through the quiz data menu in the admin dashboard. Admin can send the results directly to the user via an email that has been filled in by the user.
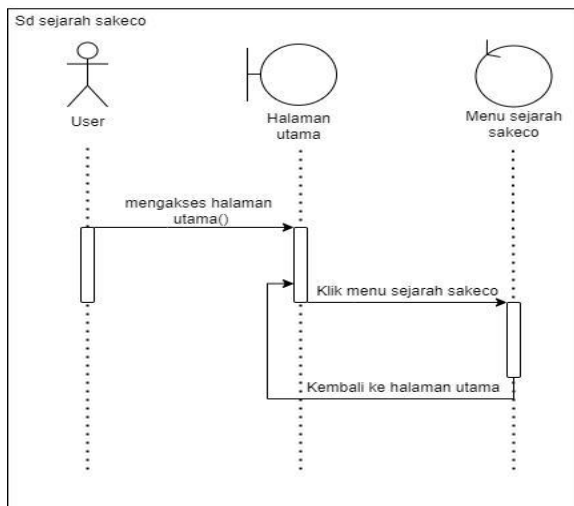
Fig. 4. Sequence Diagram History of Sakeco

Fig. 4 describes the sequence diagram of Sakeco history. The process starts when the user opens the information system, and the first one that appears is the main page. The user can click on the Sakeco history menu on the main page. The look that appears when the Sakeco history menu is clicked is information about the origin of Sumbawa Sakeco. Suppose the information has been obtained. Users can return to the main page.
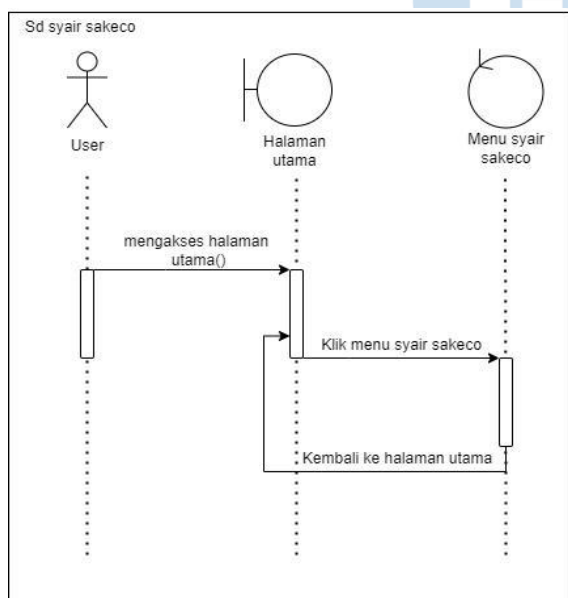
Fig. 5. Sequence Diagram Verse

Fig. 5 describes the Sakeco Verse diagram sequence. The process starts when the user opens the application, and the first one that appears is the main page. The user can click on the Sakeco Verse menu on the main page. When the Sakeco Verse menu is clicked, the look that appears is information about Sakeco Verses. If the information has been obtained, the user can return to the main page.
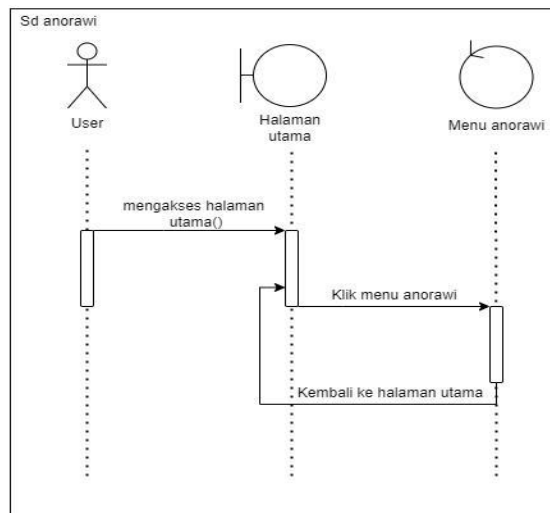
Fig. 6. Sequence Diagram Anorawi

Fig. 6 describes the sequence of Anorawi diagrams. The process starts when the user opens the application, and the first one that appears is the main page, and the user can click on the Anorawi menu on the main page. When the Anorawi menu is clicked, the view is information about anarowi. If the information has been obtained, the user can return to the main page.
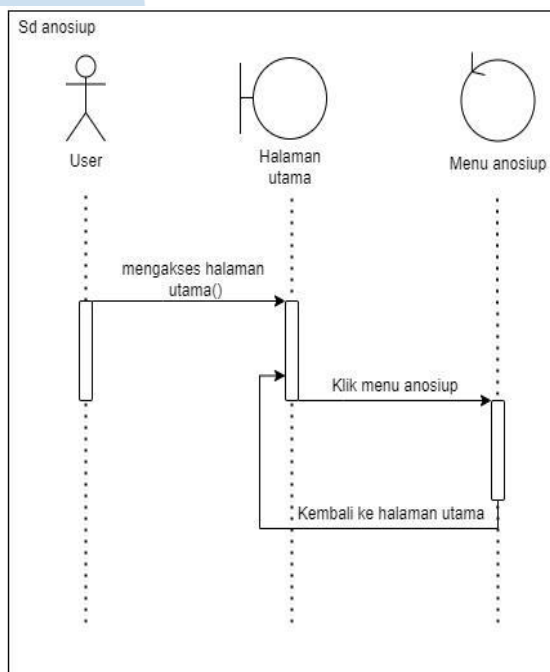
Fig. 7. Sequence Diagram Anosiup

Fig. 7 describes the sequence of Anosiup diagrams. The process starts when the user opens the application, and the first one that appears is the main page. The user can click on the Anosiup menu on the main page. When the Anosiup menu is clicked, the view is information about Anosiup. If the information has been obtained, the user can return to the main page.
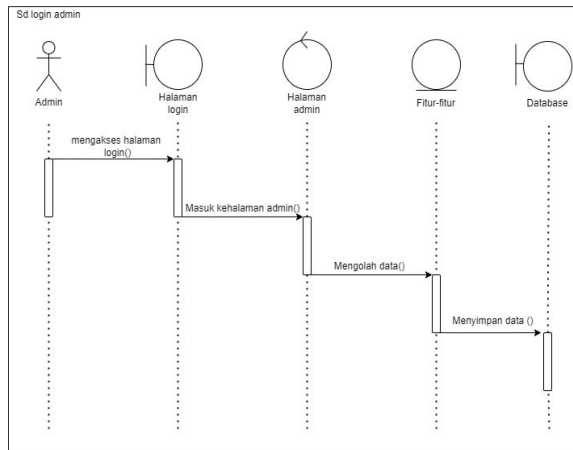
Fig. 8.   Sequence login Admin

Fig. 8 describes the admin login diagram sequence. The process starts when the admin opens the application, and the first one that appears is the login page. After the admin goes to the login page, the admin can go to the features page to process the data. After the admin has finished processing the data, the admin can enter the database to save the data.
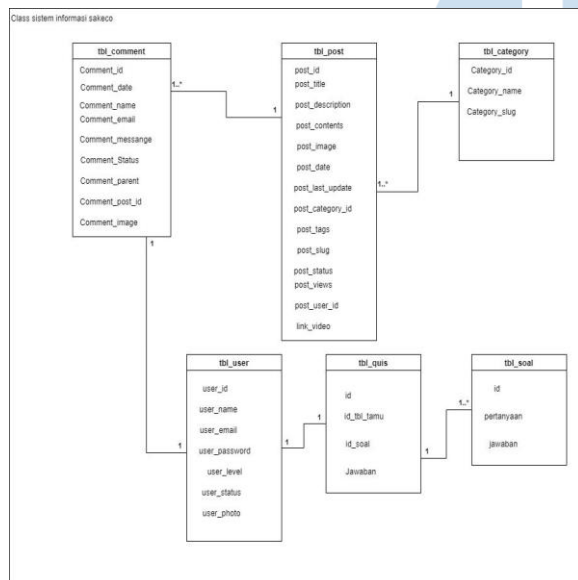
Fig. 9.   Class Diagram Sakeco Introduction Information System

Fig. 9 is a class diagram in accessing the information system of oral literary recognition of Sakeco typical of Sumbawa based on a website that describes each class can be seen and related between class one and another class.

C. Coding and Testing

The coding stage uses HTML with bootstrap framework and PHP as a programming language [20], [26]. Text editor creates information systems using visual studio code. The black box testing method is used for the system testing stage because it highlights functionality based on user needs specifications [19]. MySQL was chosen as a database system because it is free and widely used [27].

IV. RESULT

Based on the analysis and design stage, the next step is the implementation of information systems with code. The results of implementation of the information system for the introduction of oral literature Sakeco typical of Sumbawa based on the website include several parts, namely as follows:

A. Admin Login Page Implementation

This page grants admins access rights to use the information system. The admin login page consists of an email textbox, a password textbox, and a login button. The login button serves to process the email, and the password is appropriate or not to proceed to the next page. The admin login page can be viewed in Fig. 10.
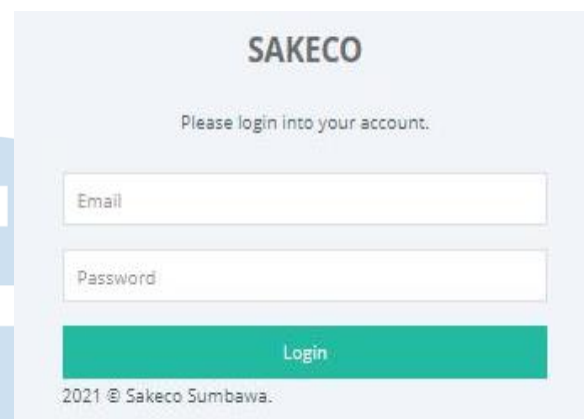
Fig. 10. Admin Login Page View

B. Admin Main Page Implementation

The main admin page is the initial view on the admin account after successfully logging in. This page has several menus, including posts, problem data, quiz data, users to view admin data, settings to set the website's appearance and log out to exit the information system. You can see fig. 11.
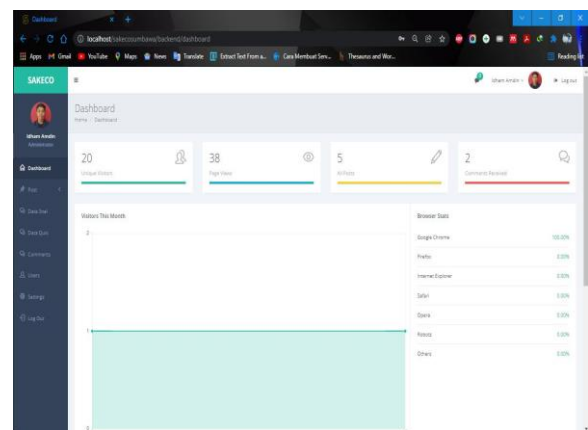
Fig. 11. Admin Main Page View

C. Admin Post Page Implementation

The posted menu has several sub-menus, including add new to add new posts, a post list to see the list of

posts posted, a category to see posts by category, Tags to see groups of posts. Can be seen in Fig. 12.
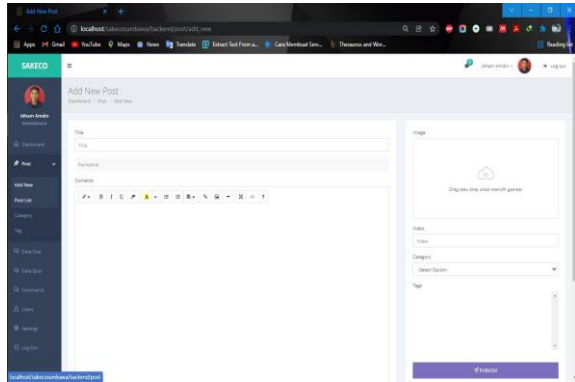
Fig. 12. Admin Post Page View

D. Admin Question Data Page Implementation

Admins use this page to see questions that have been inputted, answers to questions, perform livelihood actions, edit and delete questions, and admins can edit questions and answers, which can be seen in Fig. 13.
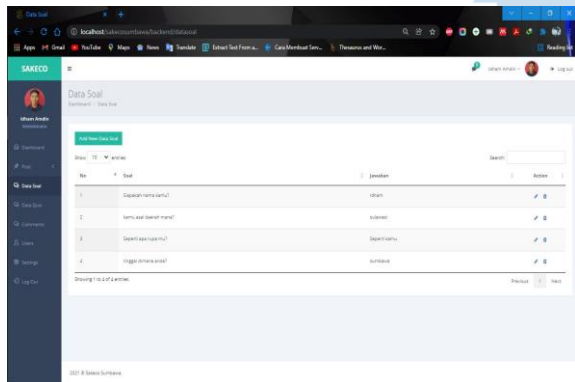
Fig. 13. Admin Question Data Page View

E. Admin add Question Data Page Implementation

Add new data questions can be seen in Fig. 14, where admins can enter questions, correct and false answers. The answers that users see in multiple choices will be random.
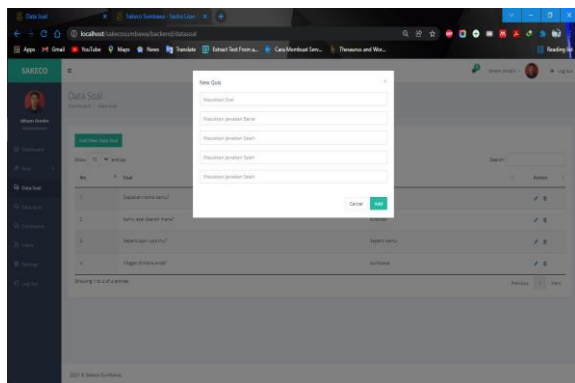
Fig. 14. Admin add Question Data Page View

F. Admin Quiz Data Page Implementation

Admins use this page to see the data and answers of users who have filled in quizzes. Seen in Fig. 15.
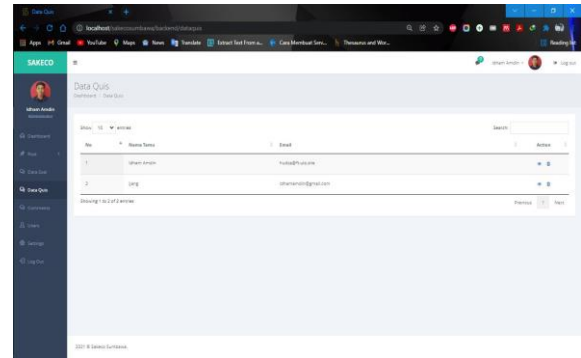
Fig. 15. Admin Quiz Data Page View

G. Admin View Quiz Data Implementation

Admins use the action of viewing quiz data to see details of the names and emails of users who have answered the quiz, as well as see the answers that have been selected and this feature is expected as a cultural learning media to maintain and preserve the current culture. Can be viewed in Fig. 16.
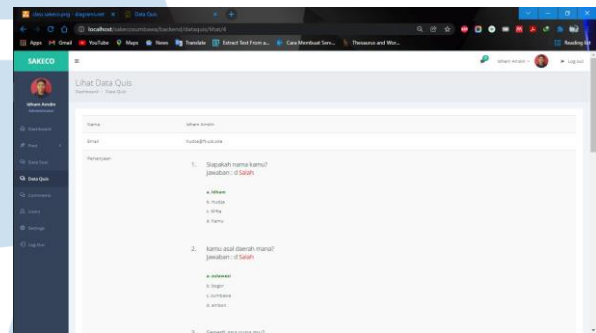
Fig. 16. Admin View Quiz Data

H. User Home Page Implementation

The user's main page is the initial display of the information system that will be seen by the user/visitor. This page has several menus, including quizzes, history, verses, Anorawi, Anosiup, and latest posts to see the latest posts and popular posts to see the most opened posts. You can see fig. 17.
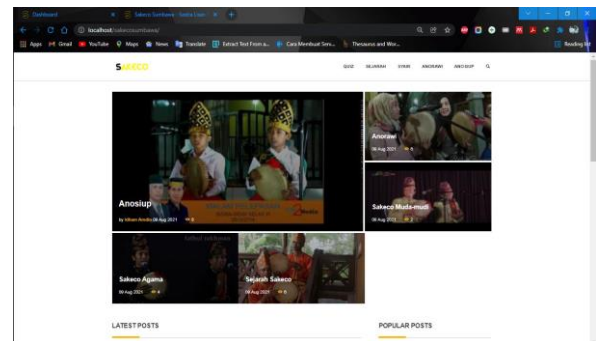
Fig. 17. User Home Page View

I. User Quiz Page Implementation

Users use this page as a learning medium to test their discussion of posts that have been read. The user must enter the name and email, answer the question, and then submit to see the correct answer. It can be seen in Fig. 18.
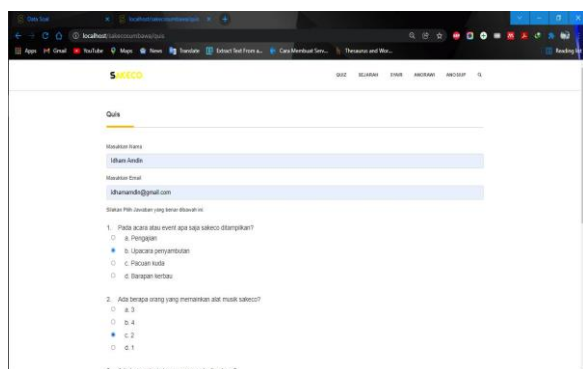
Fig. 18. Quiz User Quiz Page View

J. History, Verse, Anorawi and Anosiup Page for users Implementation

Users use this page to get the information they want. This page contains videos that have been embedded from Youtube, then equipped with captions. Anosiup pages that have been clicked or in cannot be seen in Fig. 19.
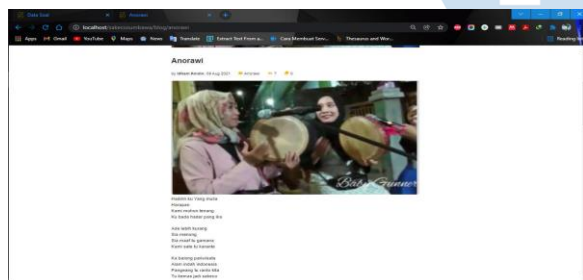
Fig. 19. User Anosiup Page View

K. Information Systems Testing

In testing information systems using the black box testing method. The test involved Mr. Ariffianto as a user and Mr. Herfandi, M. Kom as an IT experts. Black box test results as presented in Table I.

TABLE I.   BLACK BOX TESTING RESULT

Test Scenarios	Expected results	Result
Login Page Testing		
Input email and password correctly	The system will go to the admin's main page	Appropriate
Admin Home Page Testing		
Click the add post button	The system will go to the add post page	Appropriate
Click the data button about	The system will go to the add data page about	Appropriate
Click the quiz data button	The system will go to the guest page that has answered the quiz	Appropriate
Click the log out button	The system will log out and return to the admin login page	Appropriate
Post Page Testing		
Fill in the data add posts, videos and images	The post will appear on the user's main page	Appropriate
Click the publish button	The post will appear on the user's main page	Appropriate
Question Data Page Testing		
Click the data button about	The matter will go to the view of the plus question	Appropriate
Question Data Add Testing		
Fill in the added data about	the post will appear on the user quiz page	Appropriate
Quiz Data Page Testing		
Click the quiz data button	Can see a list of users who have filled out the quiz	Appropriate
Quiz Results Page Testing		
Click on the results of quizzes that have been filled in by the user	quiz results that have been filled in by the user	Appropriate
User Page Testing		
Click the quiz button	Will go to the quiz page	Appropriate
Click the Sakeco history button	Going inside the Sakeco history page	Appropriate
Clicking the Sakeco Verse button	Going inside into the Sakeco Verse page	Appropriate
Clicking the Anorawi button	Will go into the Anorawi page	Appropriate
Clicking the Anosiup button	Will go inside the Anosiup page	Appropriate
Quiz Page Testing		
Fill in the name, email and answer quiz and click the save button	The data will be logged in and stored in the admin page	Appropriate
History Page Testing		
Click on the Sakeco history picture that is in the information system	Will be included in the historical display of Sakeco	Appropriate
History View Page Testing		
View Sakeco history pages	Can see the history of Sakeco	Appropriate
Verse Page Testing		
Clicking on the image of Sakeco Verse in the information system	Will be included in the Sakeco Verse display	Appropriate
Verse View Page Testing		
View Sakeco Verse pages	Can see Sakeco Verse	Appropriate
Anorawi Page Testing		
click the Anorawi image that is in the information system	Will enter in Anorawi view	Appropriate
Anorawi View Page Testing		
View the Anorawi verse page	Can see Anorawi	Appropriate
History Page Testing		
Click on an Anosiup image that is in the information system	Will be included in Anosiup view	Appropriate
History View Page Testing		
View Anosiup page	Can see Anosiup	Appropriate

V. Conclusion

Based on the research that has been done, conclusions can be drawn: (1) Development methods using waterfalls, research methods using qualitative and information system testing using black-box testing that gets results according to expectations from various functionality tests. (2) Information systems are built based on websites using HTML framework bootstrap and PHP as programming languages and designing methods using Unified Modeling Language (UML). (3) Sakeco's typical Sumbawa-based oral-literary recognition information system has the following admin features: Post to add new posts, problem data with creating, record, update, delete, and searching for quiz needs, users to view admin data, and settings to organize posts and website views. While users: doing quizzes and seeing answers as a learning medium, looking at the history of Sakeco, Sakeco Verse, Sakeco Anorawi, and Sakeco Anosiup, and latest posts to see the latest posts and popular posts to see the most opened posts.

This research needs to be further developed in the future. Therefore, it is expected that in the future, it can add chat features for users and be made in its mobile version.

Acknowledgment

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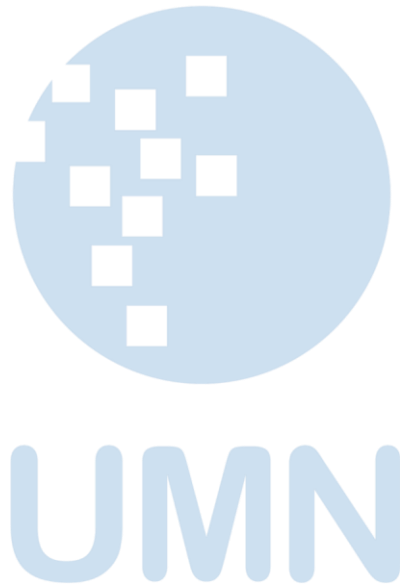
Restaurant Transaction Application Based on Android System

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Abstract— **This study was conducted to see the impact of COVID-19 to transactional activity in restaurant, especially for dine in and take away services. This study aims to help people to transact easily, comfortably, and safely in a restaurant. Other than that, this study aims to help restaurant management activity to be better. This study was developed using lead startup method to give a proper solution. Solution was made in a mobile application for android using Flutter technology. The main features of this application are (1) search for merchant and looking at the available capacity, (2) doing reservation, (3) ordering food for dine in and take away, and (4) doing cashless payment systems in the application also help users to reduce contact with waiters and cashiers.**

Index Terms— **COVID-19; Dine In; Restaurant, Technology; Take Away; Transaction.**

I. INTRODUCTION

Restaurants are familiar to us. Almost everywhere, we can find restaurants, be it in malls, in shop houses, even on the side of the road. According to the Regulation of the Minister of Tourism and Creative Economy No. 11 of 2014 article 1, restaurant is a business providing food and beverage services equipped with equipment and supplies for the process of making, storing, and serving in a fixed place that does not move with the aim of making a profit. Nowadays, restaurants have become part of the lifestyle and culture [9]. Many people go to restaurants to eat, chat, spend their free time, do work, and hang out. This is also supported by data on the growth of the restaurant industry which has continued to move up rapidly in the last decade. according to a survey conducted by Data Industry Research (2021), the restaurant industry has experienced a growth of 50.77% from 2010 to 2019. Based on these data, it can be concluded that the restaurant industry experienced an average growth of 5.64% per year.
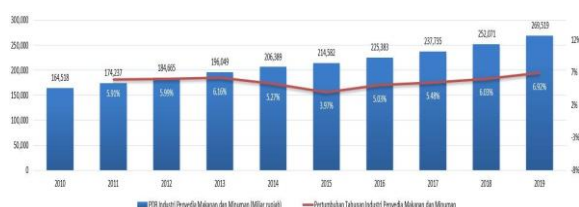
Fig. 1. Graph of the Growth of the Restaurant Industry in 2010 – 2019

However, in this era of increasing restaurant trends, many restaurants are still implementing the traditional system. Many restaurants still carry out various traditional activities, causing the effectiveness and performance of the restaurant to be low [22]. As a result, new problems arise such as loss of concentration of employees, incorrectly delivering orders, double orders occur to the large pile of menus and notes [6]. Not yet finished with the problem, as quoted in Kompas.com, on March 2, 2020, the Indonesian government announced that the COVID-19 virus had entered Indonesia [28]. Because the COVID-19 virus can spread quickly, the Indonesian government has adopted a policy of imposing Large-Scale Social Restrictions (PSBB) to reduce its spread. With the implementation of the PSBB, almost all activities have changed, such as schools being conducted online, working at home or work from home, and various other activities have become restricted,including trade in restaurants. As quoted by CNBC, the Governor of DKI Jakarta, Anies Baswedan, said that during the PSBB, transactions in restaurants were only allowed at 50% of the restaurant's capacity [29]. In addition, the frequency with which people go out of the house has decreased because they are afraid of being infected with COVID-19 [30]. [3] also stated that currently there has been a perception in society that eating and transacting activities in restaurants has a higher percentage of being exposed to COVID-19 than other places. This causes a decrease in the number of transactions in restaurants. According to data submitted by Research Industry Data (2021) in 2020 the restaurant industry production decreased by 6.89%. In addition, according to Sutrisno Iwantono, as deputy chairman of the Indonesian Hotel Association (PHRI), in 2020 there will be 1,033 restaurants that are permanently closed. The general chairman of the Cafe and Restaurant Entrepreneurs Association (Apkrindo), Eddy Sutanto, said that currently restaurant activities depend on controlling the pandemic. Although many transaction activities have shifted to delivery or take away systems, they have not been able to cover the loss of potential income by dine-in or dine-in. Therefore, to encourage transaction

activities in restaurants during the COVID-19 pandemic, it is necessary to implement and improve health protocols [8].

Therefore, This research aims is to help transact activities in restaurants by utilizing technology, both for dine in and take away. This research aims is to create a mobile application where restaurant visitors can immediately see the menu, make orders and reservations, to make digital payments (cashless). In addition, visitors can also see the available restaurant capacity. Through this application, This research aims is to improve the convenience, comfort, and safety of restaurant visitors when transacting at restaurants by reducing physical contact that occurs between visitors and restaurant employees or other visitors. This research aims is to make the mobile application which can make easier the visitors of the restaurant management activities in terms of managing order lists and payments so that there are no errors, such as wrong notes or wrong deliveries. Through this application, order information will be conveyed to the restaurant and when visitors arrive, restaurant employees can provide orders on time so that visitors do not have to wait long. In the process of developing and making applications, restaurant visitors will be referred to as users and the restaurant is referred to as merchants. With this application, this research aims is to increase the convenience, security, and effectiveness for users and merchants so that they can increase transaction activities.

II. THEORETICAL BASIS

A. Theory Relating to Software Engineering

1. Object Oriented Programming

Object oriented system is a system that focuses on capturing the structure and behavior of information systems in the form of small modules containing data and processes, known as objects [7]. Object-Oriented systems have several basic characteristics.

2. Software Development Life Cycle

Software development life cycle (SDLC) is a method for designing, building, and maintaining industrial and information systems (Alshamrani and Bahattab, 2015). Currently there are many SDLC models such as the waterfall model, spiral model, and incremental model. In its application, the SDLC models have a sequence of steps that must be followed and completed by the system maker in order to complete the required product.

3. Unified Modeling Language (UML)

Unified modeling language (UML) is a model language that can display various aspects of a software application system [24]. Currently, UML has become a general modeling language for many purposes [24].

4. Eight Golden Rules

The eight golden rules are fundamental rules in interface design that still very applicable both in desktop devices and mobile devices.

B. Theories Related to the Research Theme

1. Mobile Apps

A mobile application is a type of software application developed to run on mobile devices such as smart phones in the hope that it can be easily carried, held and used by hands.

2. Android

Android first appeared in 2008 and has developed very quickly to date [16]. Android is a comprehensive open-source platform built on top of the Linux system by the Google team. Android is formed from a collection of XML and Java codes. In this case, Android also uses XML to manage its appearance, such as buttons, text fields, and labels.

3. Flutter

Flutter is a portable UI framework from Google for building modern, reactive, and native apps for iOS and Android [20].

4. Node.js

Node.js is a web application with high performance and expandability which is widely used in Internet of Things (IoT) applications, microservices development, frontend development, even in desktop applications [14].

5. Express

Express is a framework built for the use of the Node.js web server by simplifying the use of the API and other features [13].

6. MongoDB

MongoDB is a flexible, scalable, and feature-packed database [12].

7. Restaurant

According to the Regulation of the Minister of Tourism and Creative Economy No. 11 of 2014, a restaurant is a business providing food and beverage services equipped with equipment and supplies for the process of making, storing, and serving in a fixed place that does not move with the aim of making a profit. In its current development, the restaurant which was originally just a place to eat and drink has developed into a hangout and part of a lifestyle [9].

8. COVID-19

COVID-19 (coronavirus disease 2019) is a disease caused by a new type of coronavirus, namely SARS-CoV-2 which was first reported in Wuhan China on December 31, 2019 (Ministry of Health of the Republic of Indonesia, 2020). COVID-19 can spread through the air, goods, or food. Common symptoms include fever, dry cough, and feeling tired. Other symptoms include

aches and pains, congestion, headache, sore throat, diarrhea, loss of sense of taste, skin rash, or discoloration of the fingers or toes. About 80% of infected people recover without the need for special treatment, and another 20% suffer from severe pain and difficulty breathing.

III. METHOD

The method used for making this application is the waterfall model.
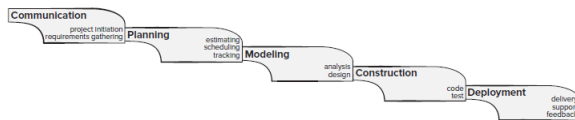
Fig. 2. Stages of the Waterfall Model [31]

Based on Figure 2, the following is an explanation for each stage of the waterfall model:

1. Communication

Communication is the stage to collect information and needs from the market as well as application features and functions. In this project, this research aims is makes observations on the market and finds problems. After that, This research aims is also distributed questionnaires to see what the market needed. After that, the results of the questionnaire were analyzed to produce the actual problem and the required solution.

2. Planning

For this step, the research aims is to plan a timeline in making an application, technical task and the requirements that needed to develop an application.

3. Modeling

At this stage, all information and requirements are converted into structural models that are easy to understand and assist in the development process later. The model used is UML which consists of use cases, activity diagrams, sequence diagrams, and class diagrams.

4. Constructions

The construction stage is the stage of making the application. At this stage, the model design in the form of UML is translated into the dart programming language for the client side using the flutter framework and Node.Js with the express framework for the server side. At this stage testing is also carried out to see whether the application made is in accordance with what the market needs and whether the application has been able to answer these problems or not.

5. Deployment

At this stage, the Dayly application is tested and evaluated. In addition, improvements were also made to the bugs found.

As for working on this research, it has a timeline as shown in the following table:

TABLE I. DAYLY APPLICATION COMPLETION TIMELINE

Activity	Month				
	March	April	Mey	June	July
Collecting and exploring the required requirements	■	■			
Design process for the application structure		■	■		
Production process (coding)			■	■	■
Testing					■
Maintenance MVP					■

For now, there are several applications that are mostly used in Indonesia to find restaurants, make reservations, and provide reviews such as Zomato, Qraved, and Eatigo. However, the features provided are still limited to finding restaurants and addresses, merchant ratings, place reservations, and orders for delivery and take away orders. The features available are only for ordering menus and cannot make payments.

TABLE II. DAYLY APPLICATION COMPLETION TIMELINE

Fitur	Application		
	Zomato	Eatigo	Qraved
Search Restaurant	✓	✓	✓
View menu	✓	✓	✓
Give and view restaurant reviews	✓	✓	✓
Make a reservation online	✓	✓	✓
Navigation	✓		✓

Currently, there is no application that can search for restaurants, view restaurant capacity, make reservations, place orders for dine in and take away, to make payments.

A. Analysis of Problems/Needs

To know about the market needs, the questioner has already spread to 100 respondents in randomly and anonym and all questionnaires could be processed. Here are the results of the deployment:

1. What type of food do you choose?

RESPONDENTS PREFERENCE EATING TYPE

Fig. 3. Graph Respondents Preference Eating Type

Most respondents have a preference for ordering food through delivery orders (59%) and take away (21%). Meanwhile, only 20% of respondents choose to eat dine-in.

2. *For those of you who choose take away or delivery, what is the main reason you choose that option?*

Most respondents prefer delivery or take away for fear of being exposed to COVID-19 (67 respondents). In addition, respondents also prefer to eat at home with delivery or take away ser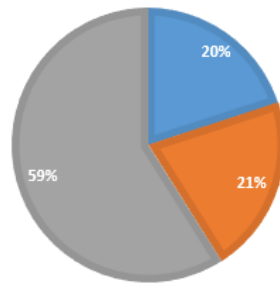vices because it is more practical, less comfortable when eating in a crowd during a pandemic, and other reasons such as promos offered by applications or merchants.

After the respondent answers the general questions above, the respondent who chooses the type of eating dine-in will be asked questions to find out the motivation, reasons, and what is important for the respondent when they want to eat dine-in, as follows:

3. *In the midst of a pandemic, how important is the implementation of health protocols in restaurants?*

It can be seen that there are 15% of respondents who think that the implementation of health protocols in restaurants has gone very well, 35% think it is good, 35% think it is quite good, 10% think it is not good enough, and only 5% think it is not good.

4. *Does the level of visitor crowd play an important role in choosing a dine-in place to eat?*

The level of crowds of visitors is one aspect that is very important to be considered by most respondents (70%). In addition, there are 25% who feel important and only 5% who feel the crowd level of a restaurant is less important.

After completing the question session above, which is specifically for respondents who choose dine-in, the following questions are questions that were asked to all respondents, both those who chose to eat dine-in, or take away or delivery. The purpose of this question is to see if respondents are interested in the features that Dayly has to offer and what can encourage respondents to go for dine-in again.

5. *We offer a feature that can tell the capacity and number of diners in the restaurant. How interesting is this feature for you to try?*

There are 58% of respondents are very interested, 24% are interested, and 12% are quite interested in the feature that can see the capacity and number of visitors of a restaurant. Meanwhile, there are 3% of respondents who are not interested, 1% are less interested, 2% are not very interested in this feature.

6. *We offer features to make restaurant reservations and place food orders. How interesting is this feature for you to try?*

There are 63% of respondents who are very interested, 22% are interested, and 11% are slightly interested in the Dayly application with the reservation and food order feature at the targeted merchant. Meanwhile, there are 2% of respondents who are not interested, 1% are not very interested, 1% are less interested in the feature.

7. *We offer a cashless payment feature so there is no need to queue and have direct contact with the cashier. How interesting is this feature for you to try?*

There are 61% of respondents who are very interested, 31% are interested, and 4% are quite interested in features that implement cashless payments. Meanwhile, only 2% of respondents felt disinterested and 2% of respondents were not very interested in the feature.

8. *What do you think needs to be done to encourage you to go dine-in today?*

The tightening of health protocols is the most important thing to be able to encourage respondents to eat dinner again (53.9%). In addition, the decline in COVID-19 cases (10.1%), the existence of qualified supporting applications (9%), surveillance and crowd restrictions (7.9%), and fresh and varied food (4.5%). While some respondents have other opinions such as promos, additional places, and other answers (14.6%).

IV. CONCLUSION

A. Proposed Problem Solving

Based on the analysis that has been carried out, it can be seen that many people are worried and uncomfortable eating dine-in due to the high number of COVID-19 cases. Most people also think that there are supporting applications that can provide certainty regarding health protocols and crowd levels so that they feel easier, more comfortable, and safer when eating dine-in or take-away without having to worry about being exposed to the COVID-19 virus. this research aims is to proposes to create an application that can ensure the implementation of visitor capacity restrictions. In addition, the application can also help the ordering, reservation, and payment process only by apps so that you don't need to have a lot of contact with other people.

Design Software Description Dayly is an application for ordering food and places, especially when you want to eat dine in and take away so that it becomes easier, more comfortable, and safer from COVID-19. In addition, Dayly also displays the number of capacities and visitors from a merchant so that users can ensure the implementation of health protocols and PSBB. Here are the features in the Dayly app:

- Search for merchants and view visitor capacity.

- View menus.

- Make a reservation for a place to dine in.

- Place orders for dine in and take away.

- Make cashless payments using bank transfer methods (Permata, BCA, BNI, BRI) and e-wallet (GoPay and ShopeePay).

- View merchant reviews

B. Application Functions and Features

This Dayly application has several functions and features that are owned by users and merchants.

1. Users

- Users can search for merchants by merchant name.

- Users can see the capacity of each merchant.

- Users can place orders for dine in or take away.

- Users can make reservations, both for dine in and take away.

- Users can make cashless payments via bank transfer or e-wallet.

- Users can view merchant ratings and provide ratings.

2. Merchants

- Merchants can manage information about their restaurants.

- Merchants can view incoming orders.

- Merchants can add, modify, and delete menus in their restaurants.

In addition to functions and features that can be used by users and merchants, the Dayly application also has certain functions and algorithms to assist the existing process. This function is a password encryption feature using the SHA-256 algorithm with the help of a library from NPM.

C. System Design

The use case reports the interaction between actors in the System safety in take away reservation (Daily Application), as shown in Figure 3.
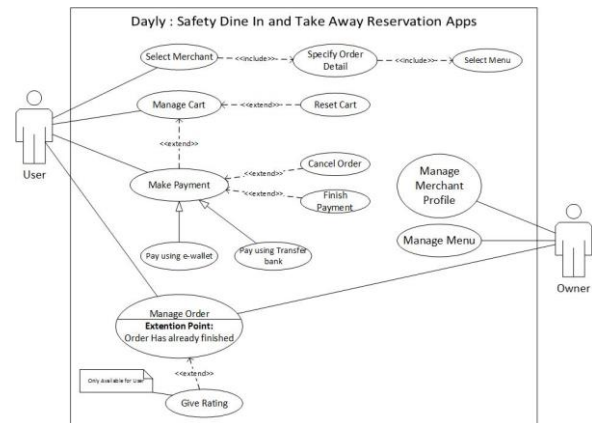
Fig. 4. Use Case Diagram

V. SYSTEM IMPLEMENTATION

In relation to the online learning process, the value Application screen design is a display design that will be applied in the application system as a display interface. The screen design stage is very important in application development because this stage analyzes and presents the UI and UX of an application that will be made. In its application uses Adobe XD to design the Dayly application screen. Here is the layout of the Dayly app:

1. Welcome Screen
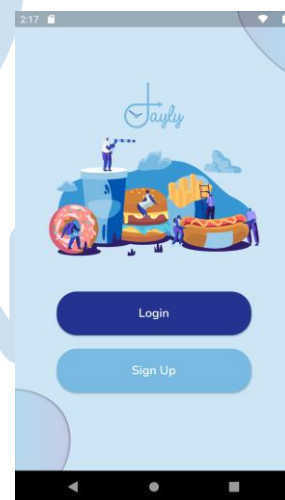
Fig. 5. Welcome Screen Design

The welcome screen is the screen that the user first sees when entering the application if the user has not logged in using the device or has logged out. On this screen, users can see an image of the Dayly logo and food illustrations, a login button and a sign up button.

2. *Explore Screen*
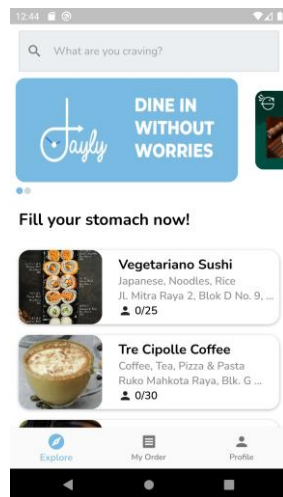
Fig. 6. Explore Screen Design

The explore screen is the screen that the user can see after successfully logging into the application. On this screen, users can see fields to search for merchant names, information banners, and a collection of available merchants.

3. *Specify Order Screen*
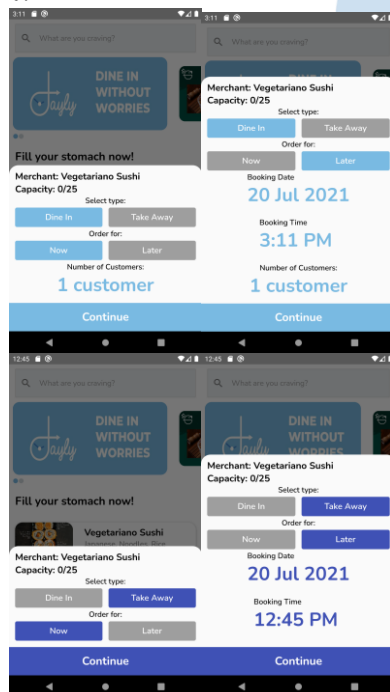
Fig. 7. Specify Order Screen Design

Specify Order screen is a screen where the user can enter information about the order to be made.
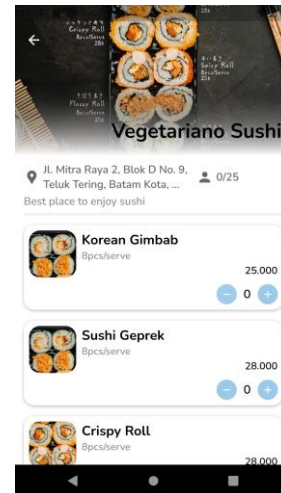
4. *Merchant Screen*

Fig. 8. Merchant Screen Design

Merchant screen is a screen that displays selected merchant data. On this screen, the user can see the available menus and select the menu.

5. *Cart Screen*

Fig. 9. Cart Screen Design

Cart screen is a screen that displays data from orders to be made and selected menus and their quantities.
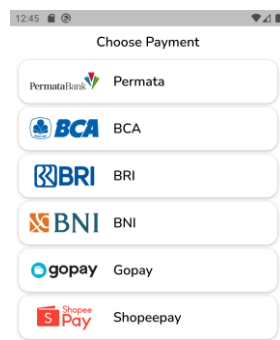
6. *Payment Screen*

Fig. 10. Payment Screen Design

Payment screen is a screen showing the various payment methods that Dayly provides. The user can choose the payment method by pressing the payment method button.

7. *Confirmation Screen*
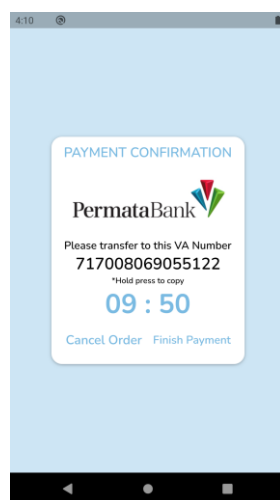
Fig. 11. Confirmation Screen Design

The confirmation screen is a screen that displays information about the selected payment method and the remaining time.

8. *My Order Screen*
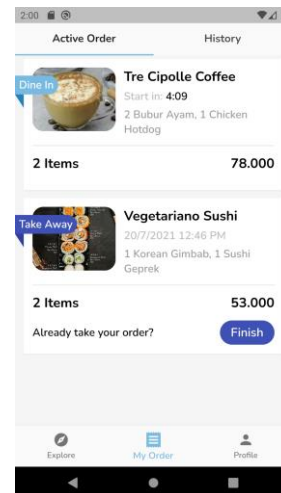
Fig. 12. Active Order Design

Active order is a screen that displays unpaid, pending, and ongoing user orders.

9. *History*
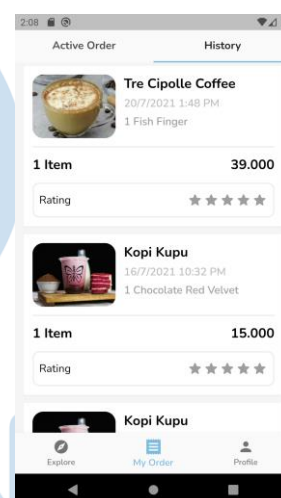
Fig. 13. History Screen Design

History is a screen that displays user orders that have been completed.

10. Give Rating Screen
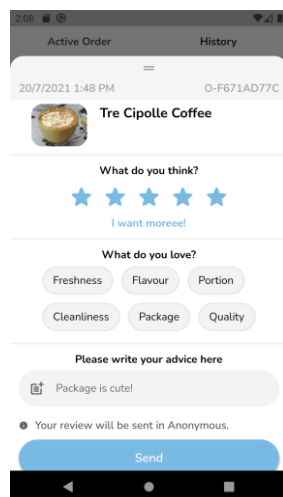
Fig. 14. Give Rating Screen Design

Give rating screen is a screen that users can provide reviews and ratings on merchants.

11. Profile Screen
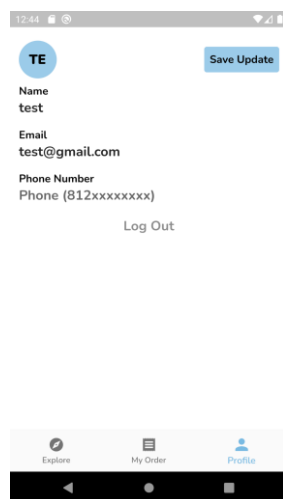
Fig. 15. User Profile Screen Design

Profile screen is a screen that displays information from the currently active user.

VI. Conclusion

The current state of the market is feeling worried when you go out to eat, especially when you dine in. This is because they are afraid of contracting COVID-19. Based on the results of usability testing and application evaluation, the Dayly application has answered the issues raised, namely that it can help and make it easier for users to transact at restaurants safely dine-in or take-away by using the feature to see the capacity of restaurants and visitors. In addition, the reservation, ordering, and cashless payment systems in the application also help users to reduce contact with waiters and cashiers. The Dayly application has advantages compared to similar applications, namely it has a feature to see the capacity of a restaurant and its

visitors and has features to make reservations, dine in or take away orders, to cashless payment processes.

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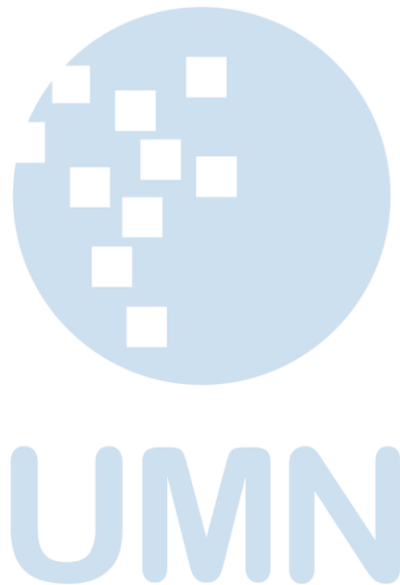
Analysis and Design of an Web-Based Ticketing Service Helpdesk at Food and Packaging Machinery Company

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Abstract— **PT Putra Chandra Sentosa is a company engaged in food and packaging machinery. In the business process that runs in the customer service division, the process of recording service submissions by customer service is carried out using word processing software which has the potential for data accumulation and the search for information on service submissions to be slower. This company is large and has 87 employees; in the customer service division, four people manage customers, and two technicians are in charge of repairing. There are quite a lot of repair requests coming in every day, with an average of 10-15 requests per day. Customer service has difficulty dividing technicians' duties due to service status updates that are not real-time, and they have to wait for technicians to submit a letter of assignment after the visit. In addition to using conventional data processing, customers who complain about service results or technician attitudes make management feel they need feedback reports regarding customer satisfaction. This study aims to design a website that is useful to facilitate the search for service information, perform a balanced division of technician tasks and assist management in seeing customer satisfaction in the form of reports. The Helpdesk Ticketing website in this study has been developed using *Website Development Life Cycle (WDLC)* model with the *Hypertext Preprocessor (PHP)* programming language, Unified Modeling Language (UML) notation and MySQL database. The *PHP* programming language is used in this research because various operating systems can run it via a browser. This research produces a Helpdesk Ticketing website that can answer the needs of the company PT Putra Chandra Sentosa. This research also proves that the website can optimize business processes in recording service submissions compared to using word processing software.**

Index Terms—Customers; Helpdesk; Service; Ticketing; Website.

I. BACKGROUND

Information technology (IT) has become an important requirement for every company to support increasing the effectiveness and efficiency of its activities [1]. The essence of the function of information technology is to create efficiencies to reduce waste generated by the company [2]. One of the benefits of implementing IT in the company is that it can provide convenience for consumers and prospective customers in accessing the product information of a company. In the industrial era 4.0, information technology has been applied in almost all industrial sectors, including the banking sector.

PT Putra Chandra Sentosa is a company engaged in food and packaging machinery. This company has four business units located in Jakarta, Surabaya, and Semarang. In addition to selling machines, PT Putra Chandra Sentosa also attaches great importance to service to post-purchase customers by providing service centres in its business units. Customers can make complaints by coming directly to the service centre or telephone. Internally, the company records the service using a working paper containing customer complaints and data called a service call and then inputs it into the Microsoft Word software. The technician who will perform the service is selected by Customer Service by looking at the status of the unfinished assignment letter from each technician.

Meanwhile, there is a delay in updating the service status because they have to wait for the technician to submit their assignment letter after the visit. It will only be updated by Customer Service, causing frequent unfair/even distribution of tasks. When servicing, the technician will record every process carried out on the technician's assignment letter. This condition causes the risk of loss and damage to the assignment letter to be unavoidable, and customer service often has difficulty finding service information because the records only use paper. The service that the technician has completed is not a guarantee that the customer is satisfied. Sometimes some customers complain about the attitude of the technician because the positive or dissatisfied feedback from the customer is not recorded correctly, making management feel the need to look at the feedback report from the customer.

This research was conducted based on previous research that focused on the Analysis and Design of a web-based information system using the WDLC model, which has been successfully deployed and implemented in the website content management system (CMS) for

managing the website [3]. The following research focuses on the analysis and design of a website-based helpdesk ticketing with the prototyping method that was successfully created, making it easier for users to report problems, and making it easier for IT technicians to manage reports [4]. The following research aims to develop a website-based help desk ticketing application to help IT technicians and employees, especially IT technicians, provide information and management reports to devise problems quickly and accurately [5].

Based on the results of the previous research that is still related to this research, to give a solution to the company's needs in customer service problems, a system is needed to facilitate and simplify the business process. This study aims to produce a website-based helpdesk ticketing system that will be developed using the Website Development Life Cycle model and test the functionality aspect using black-box testing before being implemented in the company.

II. METHODS

In the present turn of events, there is no a standard procedure or rule which we can be continued in creating static site. Despite the fact that the course of the web improvement has likenesses with the interaction in ordinary programming advancement life cycle (SDLC) model, still there is a need to have a very much custom fitted or committed methodology for web improvement dependent on explicit prerequisite [6].

The term of web improvement life cycle (WDLC) that is utilized by many web engineer can be misconstrued in term of its degree. Some of them comprehend WDLC as another model of SDLC. Some of them comprehend it as new strategies in WDLC. Additionally, some of them even comprehend it all in all new investigation of SDLC as a result of its overall term of WDLC itself. Notwithstanding of the issues, the thought behind WDLC is to plan a particular methodology for web improvement particularly for static web advancement. The methodology may not be an entirely different model of SDLC yet it could be an inference of SDLC model that infers with the run of the mill interaction of web improvement life cycle.

The methodology depends on the current innovation and might be shifts later on. Concerning today, the generally utilized of web content administration framework (CMS), progressed web composing instruments that can facilitate the most common way of prototyping to execution stage are major contributing variables of why this methodology is present at the primary spot.Consequently, it is important to comprehend SDLC which incorporates the philosophies and the models inside every one of them. Additionally it is likewise essential to comprehend the site trademark and its sort like static site and dynamic site. Besides, understanding the most recent and ordinary advancement process patterns is likewise significant as it will recognizes the advances includes in it. Thus, the data will assist with deciding

the suitable model of SDLC and consequently can be inferred by web improvement life cycle patterns. The design method using the WDLC (Web Development Life Cycle) model is a step in developing the website cycle model. Although the Waterfall model introduced in the SDLC (System Development Life Cycle) model provides a sequential structure for Software Development, but WDLC provides a basic structure that also includes various guidelines for meeting the requirements with the final product. It can be adopted by all types of web application development processes such as waterfall, prototyping, and spiral. This model can also be modified to include a Prototyping structure to improve the quality of the website [6].

Structured analysis and design is an approach to solving problems in a business activity into small parts that can be compiled and linked and then can be put back together into a single unit that can be used to solve problems. Structured techniques focus on data and processes [6]. Structured analysis and design are used because it is a method that is commonly known in various industries, is relatively simple and easy to understand, and has been applied for a long time so that this method is feasible to use, relatively simple, and easy to understand [7]. The system design includes the Create, Read, Update and Delete (CRUD) functions on the Content Management System (CMS) of the web-based Ticketing Helpdesk Service [8].
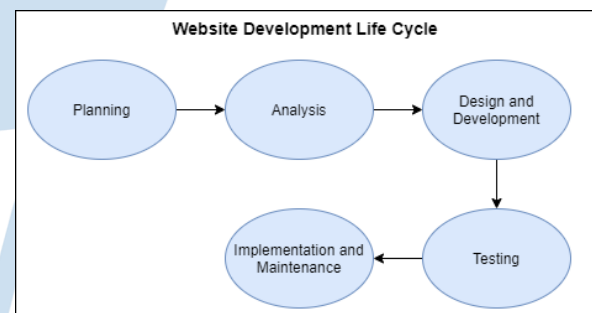
Figure 1. WDLC Model

A. Planning

The planning stage is the initial stage of designing a website using the WDLC method. Identifying the goals and objectives of the website to be built is the first step in the planning process. After the purpose is known, it must understand the criteria for system users. Then determine the website technology that will be used and identify who will later be involved in the website. After that, determine where the information will be distributed later.

B. Analysis

At this stage, user needs are identified by collecting information from users, systematically analyzing the function of the system to be created, what data is needed and where the data is

collected, and what results from you want to get from the system. After this is done, then the Analysis of the function of the system can be carried out by considering the processes needed to support the features on the website.

C. *Website Design and Development*
At this stage, prepare a blueprint for the website to be created. Then also various diagrammatic representations of logical and physical objects. The main objects include the data model, process model, and presentation model. Next, document the system design. The website composition stage includes planning site format and acquires the imaginative UI-UX creators to the cutting edge. The format includes planning an unpleasant sketch, which might be graphical, to get a vibe of the plan of the site. The reason for the design is to introduce a data structure, empowering a visual visit through the substance and base highlights for your customers. The wireframe planned in the last stage is changed into buttons, tabs, menus, dashboards, shading topics, typography, and illustrations to make a base design of the site. In order to give the user interface more easy to use and user friendly, in this stage has been implemented the Bootstrap and CSS Framework. Bootstrap is a CSS framework that was developed by Twitter developers in mid-2010. Before it officially became open source, Bootstrap was known as Twitter Blueprint. Until now, bootstrap version 3.3.7 has been released and has become one of the most popular front-end frameworks and an open-source project in the world. Bootstrap is described as simple CSS but built with a preprocessor which provides more power and flexibility than standard CSS. Bootstrap already provides CSS classes and integrates with JQuery. Responsive layout in CSS bootstrap with 12 column grid system produces a website layout that automatically adjusts to the width of the user's browser. This is what causes Bootstrap to support all types of devices such as smartphones, tablets, laptops, or desktop PCs. In addition, bootstrap also supports HTML 5 and CSS 3 [11]. In addition, to optimize the user interface, this stage is also developed using Responsive web design, which is about creating web pages that look good on all devices. A responsive web design will automatically adjust for different screen sizes and viewports. Responsive web design uses HTML and CSS to automatically resize, hide, shrink, or enlarge a website to make it look good on all devices (desktops, tablets, and smartphones).

D. Testing using Black-box Testing
The testing stage shows how the work of the website builder is, whether the results of the website that have been created are the same as the

expectations of the users, from the information needed to the performance obtained. The components tested in this stage include content, functionality, usability, and system accuracy. The outcome of this research will be tested using Black-Box testing, a software testing method in which the functionalities of software applications are tested without having knowledge of internal code structure, implementation details and internal paths. Black Box Testing mainly focuses on input and output of software applications and it is entirely based on software requirements and specifications. There are three types of Black Box Testing such as: Functional testing, Non-Functional testing and Regression testing. The test focuses on the functions of the system to ensure that the user can use the existing functions on the system [9][10].

E. Website Implementation and Maintenance
In the implementation phase, the website is placed in the user's computer to interact directly with the system, and the user gets the opportunity to work on it for the first time [12][13].

III. RESULTS AND DISCUSSION

In the description of the current procedure, it can be described as follows:

1. Customers Make Service Requests.

   Complaints/service submissions made by customers can be made by telephone or directly coming to the service centre. Usually, customers who have difficulty carrying a large machine can make a complaint by telephone for a service visit. Customers who have small machines can come directly to the service centre with a machine. Customers notify the problems experienced by Customer Service.

2. Customer Service Make a Service Submission Form.

   Customer Service records customer complaints, customer data, and machine types in a service application called a service call. A copy of the service call is given to customers who come directly to the service centre as evidence that the machine is being serviced and the conditions that must be brought when picking up the machine. For customers who make complaints by telephone, Customer Service will send a softcopy service call to customers via email or social media.

3. Customer Service Selects a Technician and Creates a Technician Assignment Letter.

   Furthermore, customers who come directly to the service centre hand over the machine to Customer Service to determine the technician who will perform service on each service call.

Then customer service will make a technician's assignment letter sent via social media groups and hand over the machine to the technician. Customers who cannot come directly to the service centre waiting for a visiting technician.

4. Technicians Do Assign Tasks.

Technicians carry out machine work under the letter of assignment. Some technicians conduct service visits, and some perform services at the service centre. The technician will notify customer service when the service has been completed.

5. Customer Service Completion.

a) For customers who request a service visit, Customer Service will call the customer to inform them that the service has been completed. If the customer disagrees, the customer will notify the customer of the lack of service to Customer Service. Then Customer Service will record and inform the technician of additional service. The technician will perform additional services and immediately notify Customer Service when the service is finished. Customer Service will notify the customer when the service has been completed. Customers who have agreed to the service, the customer, will show a softcopy of the service call and sign the service agreement completed on the technician's assignment letter to the technician. The technician will check the softcopy of the service call according to the technician's assignment letter. After receiving the signed technician assignment letter, the technician will hand over the machine to the customer.

b) For customers who do service at the service centre, Customer Service will call to notify the machine that it has been serviced and ask the customer to come to pick up the machine with a copy of the service call. Customers come to the service centre and check the machines that have been serviced. If the customer disagrees, the customer will notify Customer Service of the lack of service. Then Customer Service will record and inform the technician of additional service. The technician will perform additional services and immediately notify Customer Service when the service is finished. Customer Service will notify customer service has been completed. Customers who have agreed to the service will submit a copy of the service call and sign the service agreement completed on the technician's assignment letter to Customer Service. Customer Service, who has received a copy of the service call and a signed

assignment letter, will inform the technician to hand over the machine to the customer. Technicians hand over machines to customers after receiving instructions from Customer Service.

In the description of the proposed procedure, it can be described as follows:

A. *Proposed Use Case Diagram*

Designing the Use Case Diagram serves to make it easier to understand the system. Where this picture consists of actors as actors who interact with the system, and there are various series of activities that occur. The following is an figure of the Use Case Diagram, namely:
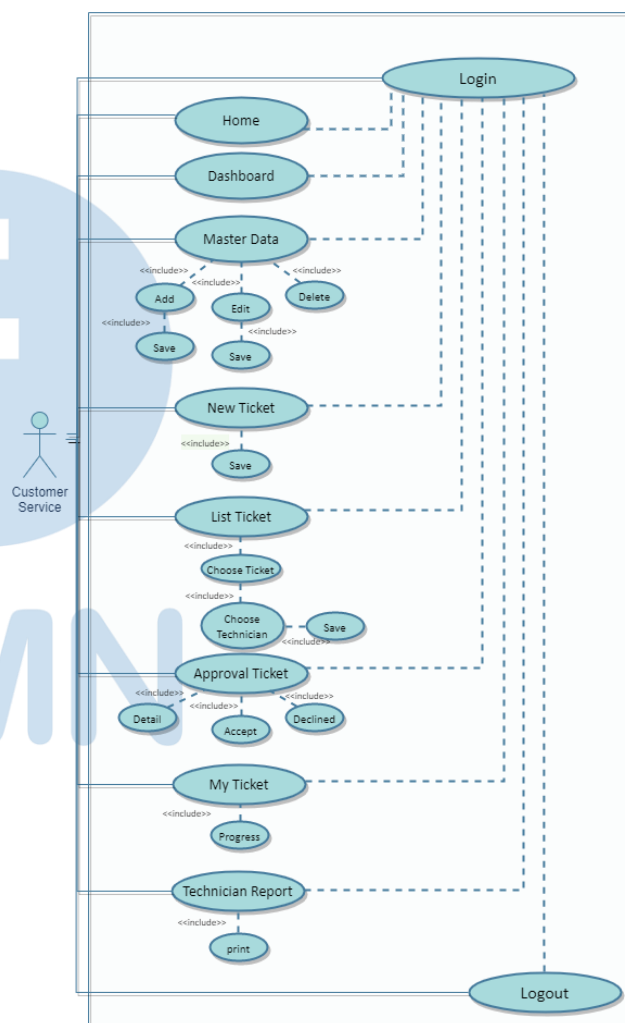
Figure 2. Proposed Use Case Diagram of Customer service

Customer service actors have several prominent features such as: home, dashboard, master data, new tickets, ticket list, approval ticket, my ticket and technician report that can be accessed after logging in. In addition, there is a log-out function to exit the website if the business process is complete.
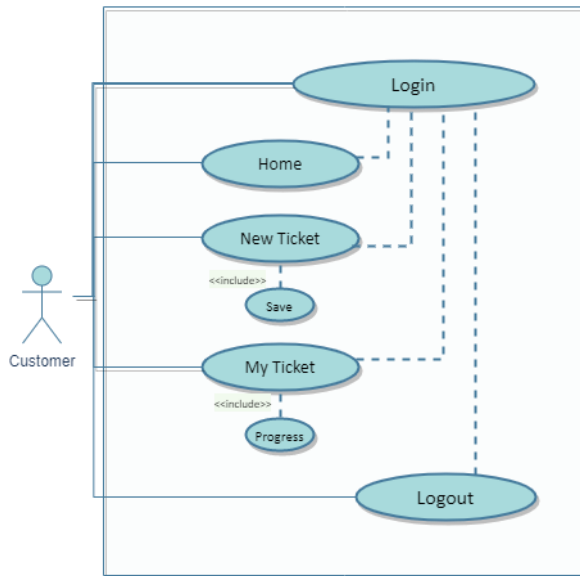
Figure 3. Proposed Use Case Diagram of Customer's

Customer actors have several prominent features such as: home, new ticket, and my ticket, which can be accessed after logging in. In addition, there is a log-out function to exit the website if the business process is complete.
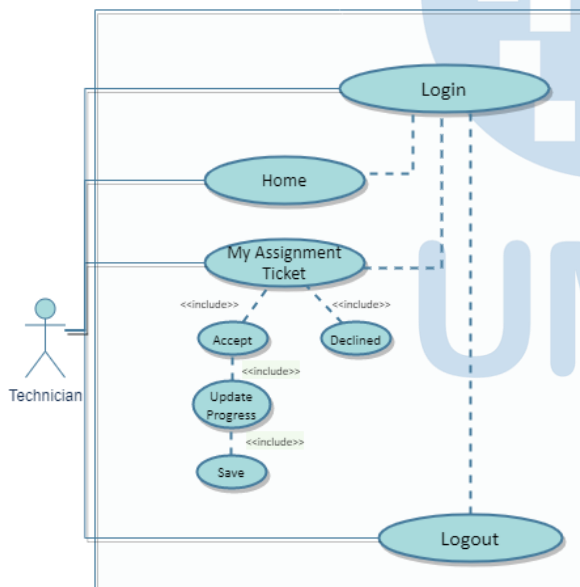
Figure 3. Proposed Use Case Diagram of Technicians

And for the last, the technician actor has two main features: home and my assignment, which can be accessed after logging in. In addition, there is a log-out function to exit the website if the business process is complete.

B. *Proposed Activity Diagram*
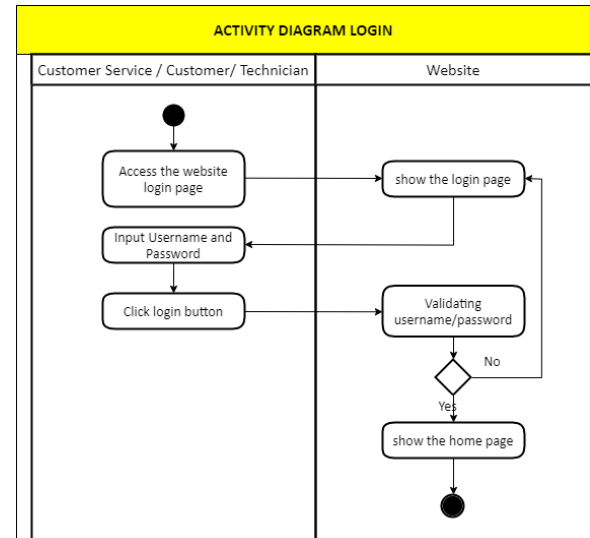
Figure 4. Login Activity Diagram

The login activity begins with the customer/customer service/technician entering the login page. The customer/customer service/technician login page displays fill in the login data in the form of a username and password. The system will display the main page when the login is successful and return to the login page when the login fails.
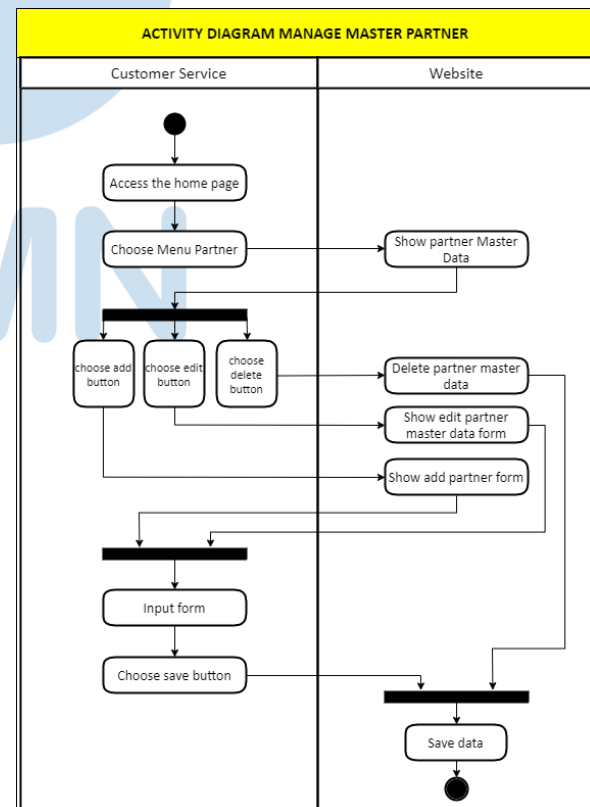
Figure 5. Master Partner's Management Activity Diagram

The master partner management activity starts after customer service enters the main page; customer service clicks on the partner menu then the system will display partner data. In partner data, customer service can add new partner data by filling in the data, then save, change partner data, and delete customer service data that is no longer needed.
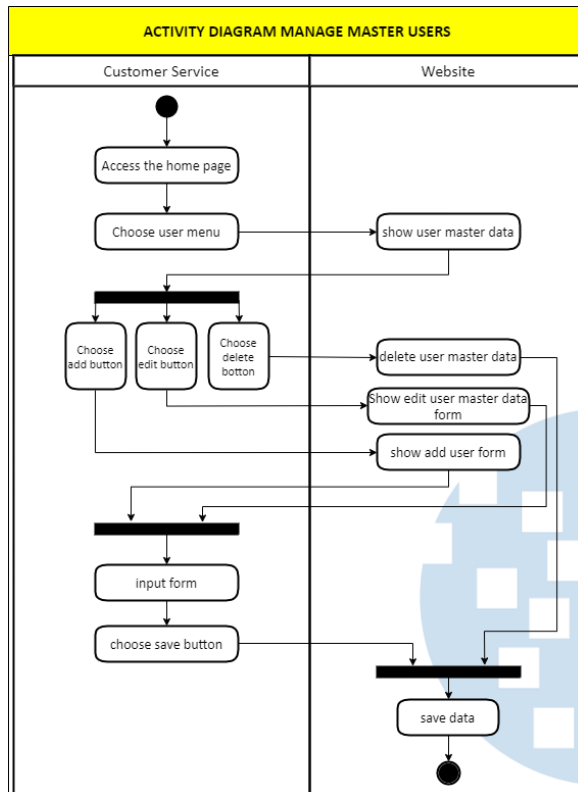
Figure 6. Master User's Management Activity Diagram

The master user management activity starts after customer service enters the main page; customer service clicks on the user menu then the system will display user data. In user data, customer service can add new user data by filling in the data, then save, change user data, and delete customer service data that is no longer needed.
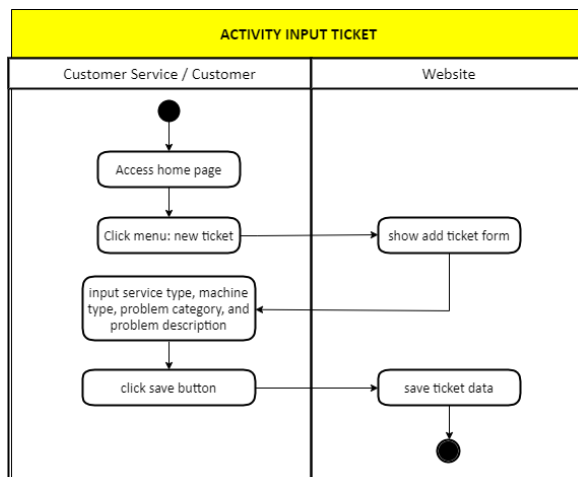
Figure 7. Input Ticket Activity Diagram
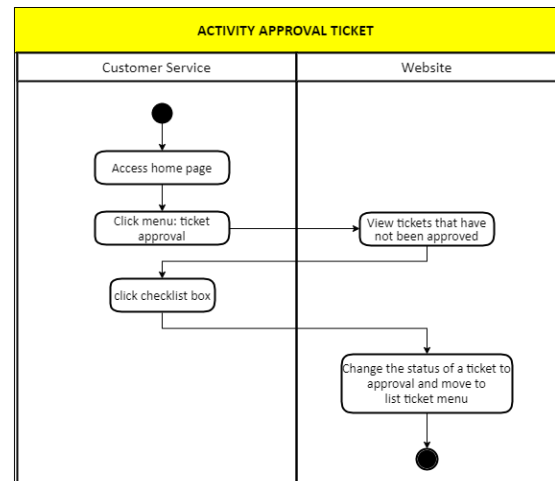
Figure 8. Approval Ticket Activity Diagram
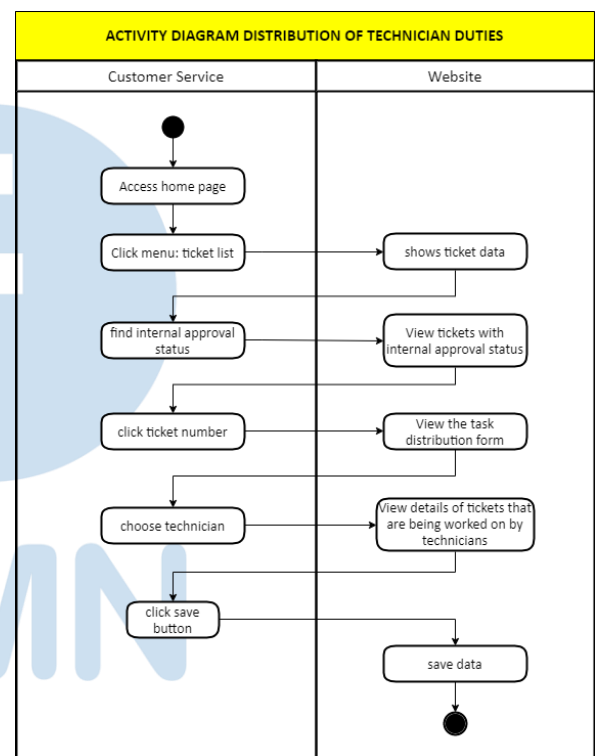
Figure 9. Technician task management Activity Diagram

The technician's task-sharing activity starts after the customer service enters the main page; customer service clicks the ticket list menu then the system will display ticket data. In the ticket data, customer service looks for tickets with internal approval status and selects the ticket number you want to divide technician duties; after clicking the ticket number, the system will display a task distribution form. On the task distribution form, customer service selects a technician who will be assigned to resolve complaints on the ticket. When choosing a technician, customer service can see all the tickets that the technician is working on. Then customer service saves the technician who has been selected by clicking the save button.
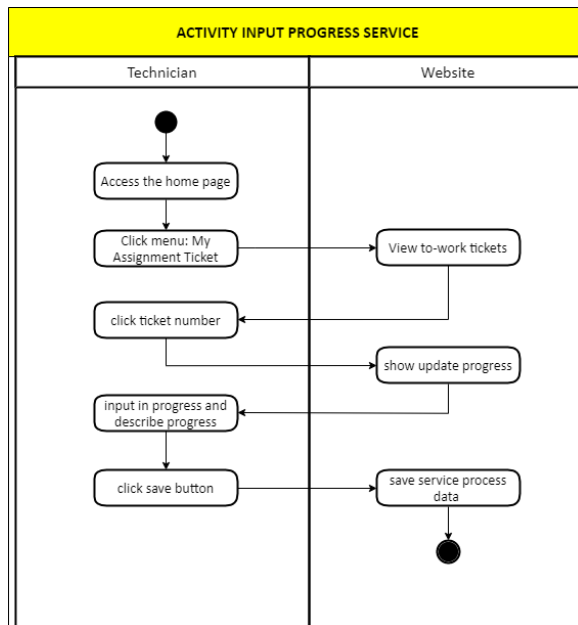
Figure 10. Input Progress service Activity Diagram

The service progress input activity starts after the technician enters the main page and clicks on my assignment ticket menu; then, the system will display the technician's task data. In the technician's task data, the technician selects a ticket number; after clicking on the ticket number, the system will display an update progress form. Then the technician fills in the progress and progress description and clicks the save button to save the data.
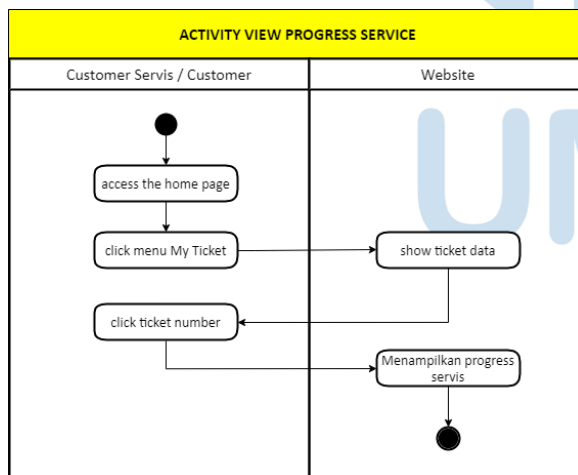
Figure 11. View Progress service Activity Diagram

The activity of viewing service progress starts after customer service/customer enters the main page, then customer service/customer clicks on my ticket menu, and then the system will display ticket data. In the ticket data, the customer service/customer selects the ticket number; after clicking the ticket number, the system will progress the service in detail.
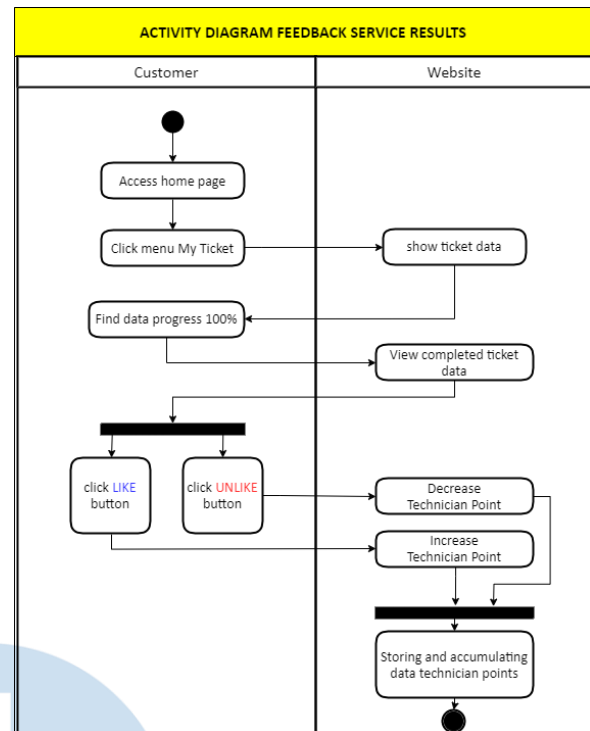
Figure 12. Feedback service results Activity Diagram

The service feedback activity starts after the customer enters the main page, then the customer clicks on my ticket menu then the system will display ticket data. In ticket data, customers look for ticket numbers with 100% progress; after that, customers can give positive feedback by clicking the like button or negative feedback by clicking the, unlike button. The system will save the points according to the feedback given.
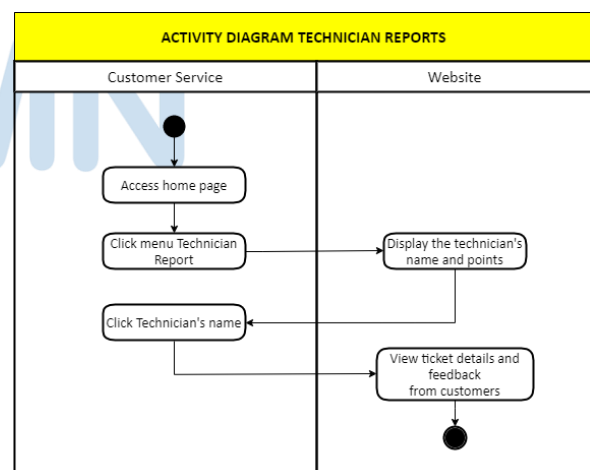
Figure 13. Technician reports Activity Diagram

The technician report activity starts after customer service enters the main page, then customer service clicks the technician report menu, and then the system will display the name and point of the technician. After that, customer service clicks on the technician's name to display ticket details and customer feedback for each ticket.
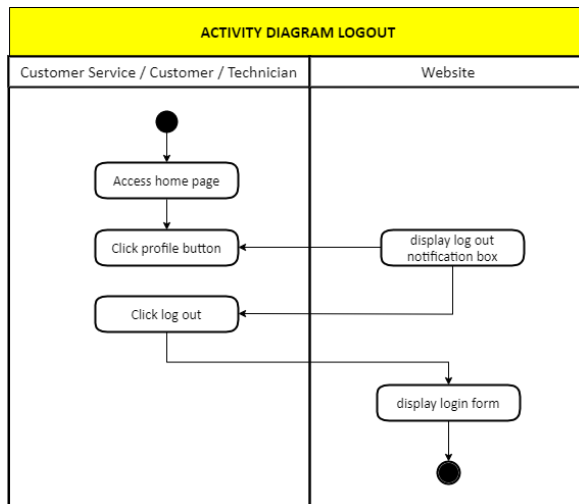
Figure 14. Log out Activity Diagram

This activity is carried out when the actor has finished carrying out activities in the system, and the actor can select a profile and click logout. Then the system will finish and return to the login page.

C. Proposed Class Diagram

The proposed Class diagram of web-based helpdesk ticketing describes eleven entities, including the attributes, operations and the relationship between these entities. That class diagram also shows us the primary key and the foreign key.
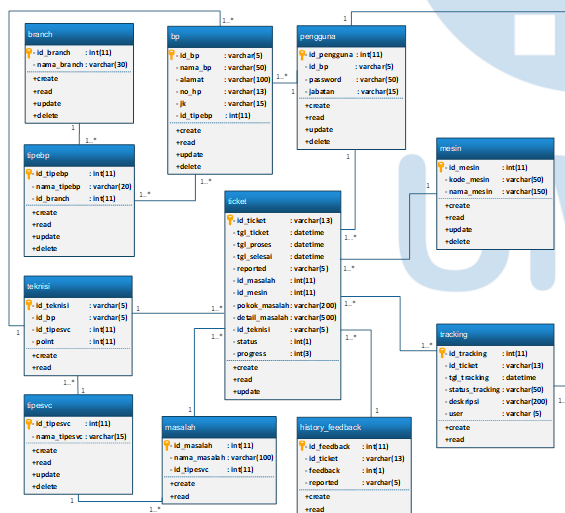
Figure 15. Class Diagram

D. User Interface

The interface to an interactive system or service, also called the user interface (UI), is all those parts of the system with which people come into contact, physically, perceptually and conceptually:

- Physically we might interact with a device by pressing buttons or moving a finger over a touch-sensitive screen. The interactive device might respond by providing feedback through the

pressure of the button or changing a display in response to a swipe.

- Perceptually the device displays things on a screen which we can see, makes noises which we can hear or behaves in a way we can feel.

- Conceptually we interact with a device by trying to work out what it does and what we should be doing. The device provides messages and other content designed to help us do this.

The interface needs to provide some mechanisms so that people can give instructions and enter data into the system: 'input'. It also needs to provide some mechanisms for the system to tell people what is happening by offering feedback and mechanisms for displaying the content: 'output'. This content might be in the form of information, pictures, movies, animations and so on. The interface may enable connectivity between devices and services provided by an environment such as the internet [14].

Figure 16. Log in form

On the login form, there are username and password fields. The field can be inputted according to the username and password of each user. If the input result does not match the user database, the system will validate and provide invalid/error notifications.
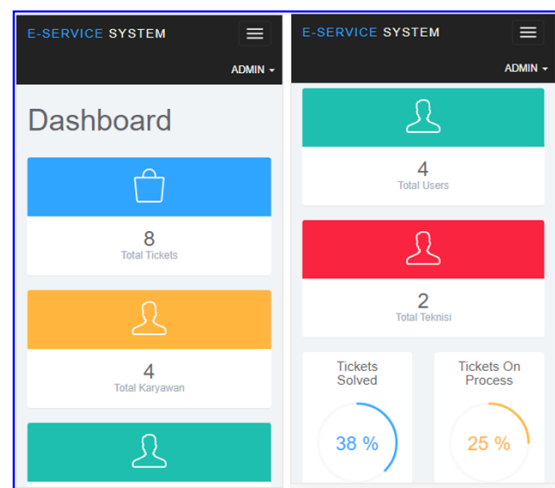
Figure 17. Dashboard

On the dashboard menu, there is a display of total tickets, total employees (customer service), total users, total technicians and the percentage of tickets that have been completed and tickets that are still being worked on.

Figure 18. CMS User's and business partner form

Figure 19. Ticketing input problem form

Figure 20. Report and problem description form

Figure 21. Report and problem description form 2

Figure 22. My Ticket menu's and status form

As for the status bar that shows with some colours, here is the explanation:

1) Waiting for Ticket Approval, namely Tickets that have just been created by customers that have not been approved by Customer Service on the New Ticket Menu

2) Approved ticket means a ticket that has been approved by Customer Service on the Approval Ticket Menu

3) ticket rejected means that the ticket is rejected by Customer Service on the Approval Ticket Menu

4) Waiting for Service Process means Tickets that the technician has not approved on the My Assignment Ticket Menu

5) In-Service Process means a ticket that the technician has approved on the My Assignment Ticket Menu

6) Cannot be serviced means a ticket that has been approved by the technician but cancelled by the technician on the My Assignment Ticket Menu because during the service process, the technician cannot repair the machine because the condition of the machine is already severe.

7) Service Completed means Tickets technicians have completed up to 100% on the technician progress page.

E. Black-box testing

TABLE 1. Black-box testing results.

The system testing phase is critical in determining a system's quality. These tests include design, specification, and coding. The testing process is done to determine the level of error that occurs in the system. The test used a black box testing shown the table below: [15]

Description	Case	Status
Log in	User's input username and password.	PASS
Add ticket	Customers / Customer Service fill in the complaint ticket and save the data.	PASS
Dashboard	The main menu to access all the feature of the web-based information systems.	PASS
Approval ticket	Customer service add the new approval of ticket.	PASS
Technician task management	Customer service choose the technician to do the service	PASS
Master data	Customer service input the data to the database..	PASS
Input progress service	Technician input the progress service.	PASS
View progress service	Customer service or customer's view the progress of the service.	PASS
Service feedback	Customers give the testimonial for the feedback on the satisfied or dissatisfied service quality.	PASS
Technician reports	Customer service view the feedback from the customer's.	PASS
Log out	User's can log out after finish the task or an activity.	PASS

At the testing stage, after testing the system using black-box testing, it can be seen that the results of testing the main functionality of the website have been in accordance with the design objectives.

IV. CONCLUSION

After all the stages are completed, it can be concluded that with the helpdesk ticketing service application, service submissions from customers will all be input into the system and stored in a database to perform the process of searching for service information. Then with technicians who can immediately update the service status without having to provide customer service after the visit, help customer service to see the status of unresolved services in real-time so that the division of technician tasks by customer service can be done relatively / evenly. As well as from the management, it is also easier to see in the form of customer satisfaction reports with the feature of providing feedback in the form of liking or disliking the service results from customers.

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Analysis of Factors Affecting Information System Security Behaviour in Employees at IT Company

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Abstract— **Most companies have prioritized a technology approach to protecting their information assets from potential attacks. The availability of information has a vital role for companies today, including confidentiality and integrity in supporting the company's performance. Users or employees are a significant factor in many information security breaches. This study aims to determine whether security education & training, information security awareness, employee relationships, employee accountability, organizational culture, and national culture significantly affect Information System Security Behavior. The analysis uses survey data from employees at companies in Jakarta and uses a structural equation modeling approach through SmartPLS 3. The results show that there is no direct and significant effect between security education & training on employee security behavior in companies in Jakarta. Security education & training affects the three mediators (Information System Awareness, Employee Relationship, and Employee Accountability), and the three mediators affect employee security behavior. The most influential variable is employee accountability.**

Index Terms—*Information System Security Behavior, Security Education & Training, Information Security Awareness, Employee Relationships, Employee Accountability.*

I. Introduction

Information Technology is the design, implementation, development, support, and management of computer-based information systems consisting of hardware or software. In this increasingly advanced era, information technology is widely used to efficiently the company's time and operational costs in processing large and substantial amounts of data [1].

The security of data or information owned by the company needs to be considered in the use of information technology. Security is an essential part of information systems because it concerns personal and confidential data belonging to users or companies. However, unfortunately, information system vulnerabilities related to data are still common. Vulnerabilities can occur due to various threats, including viruses, human error, and hacking.

In 2020, the data breach incident became a big topic in Indonesia, where millions of personal data belonging to users on various major e-commerce sites were leaked. One of the essential assets for a company is data, where much information can be used from the data. A data breach incident may result in the disclosure of PII (Personal Identifiable Information) from an individual at risk of theft or misuse of a person's data [2].

Based on the website of the State Cyber and Password Agency (BSSN) in 2021, here are the provinces in Indonesia that experienced the most data breaches from January to December 2021:
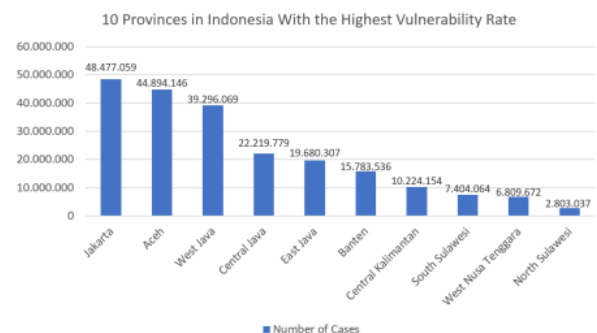
Figure 1. 10 Provinces in Indonesia with the Highest Vulnerability Rate [3]

Based on Figure 1, it can be known that data breach incidents still occur in Indonesia. The province in Indonesia with the highest vulnerability rate in Greater Jakarta province, with 48,477,059 cases.

Meanwhile, in 2021, the Garuda Eye Monitoring System detected 217.7 million cyber threats to Indonesia's internet network. Most of these threats are attempted data leaks using the Malware method [4]. This Malware is a type of ransomware that can encrypt files and directories on an infected computer, and generally, a notification will appear to pay a ransom [5]. The results of reports in 2021 from 99 firms show that 71% of the most common cyber threats are Malware that attacks company databases and blocks user access [6]. One factor that influences the threat of Malware is an element of intent carried out by irresponsible parties and the users' negligence. One example of the failure of the user himself is accidentally accessing a particular site, where the site asks for authentication or notification so that unknowingly, this will give Malware permission to enter and attack the user's computer. Some areas even show a pop-up that triggers the computer to download a file or application, which causes Malware to enter and damage the operating system without the user knowing [7].

Threats in the company are evidence that users/employees still do not have good information security awareness, so without them realizing their activities in using the company network, including the use of the internet, they can pose a threat to the security of company information [8]. Almost all companies have prioritized a technology approach to protecting their information assets from potential attacks. Some commonly used information security technologies include firewall devices, Antivirus software, IDS, and others. Although the prevention of attacks by technical means is essential, on the other hand, the risk of insider threats to information security breaches is genuine. Users or employees are a significant factor in many information security breaches. Thus, more and more attention is paid to the human side of information security [9].

Employees are the leading cause of many data breaches in companies. Information security breaches often occur due to employee ignorance or careless behavior [10]. Based on Nucleus Cyber in the 2019 Insider Threat Report seen in Figure 2, companies are more worried about unintentional/negligent data breaches (70%), data breaches due to negligence (66%), and intentional data breaches (62%).
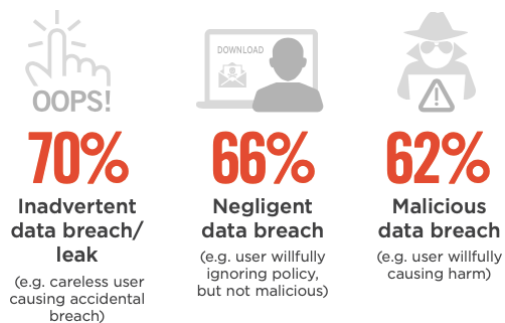
Figure 2. Types of Internal Threats [11]

In the same report in Figure 3, it is explained that the main reason for internal attacks is the lack of awareness and training of employees (56%).
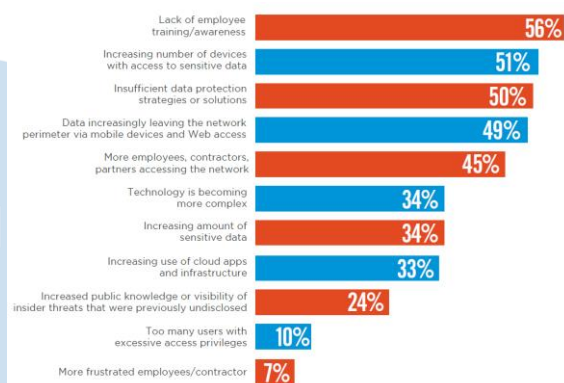
Figure 3. Main Causes of Internal Attacks

Maintaining employee compliance with information security rules is highly dependent on the employees' behavior because technical controls cannot prevent all human errors. For example, employees tend to write down passwords, share them with coworkers, or send confidential information in an unencrypted form. At the same time, other sources say that employees are the weakest link in the information security chain [12]. The main challenge for organizations is to find ways to build employee awareness and concern about the importance of information security.

Based on the Preventive Maintenance report for the period February - April 2022 at one of the IT companies in Jakarta, there are several threats:

Figure 4. Threats in IT Company

Threat	Category	Threat Level	Blocked or Allowed	Number of Incidents
A hack occurs when the old server migrates to a new server.	Brute force	Critical	Blocked	1
There was a leak of customer data.	Deliberate acts of theft.	Critical	Blocked	1

Based on the threats seen in Figure 4, there are still many employees who do not have a high awareness of the importance of information security in the company. As for the risks that occur due to threats to information security, namely, data contained in computer systems can be tampered with or deleted; data can be accessed or changed by the unauthorized user; falsification of information by unauthorized persons [13].

Threats can also occur when accessing a website without guaranteed security. There are several access violations to specific websites with different categories:

Figure 5 Website Breach at an IT Company

URL	Category Description	Action
https://www.netflix.com/browse	Media streaming and downloads entertainment	Blocked
https://web.telegram.org/	Computer & technology, instant messaging, and chat	Blocked

Based on Figure 5, the company blocked Netflix because Netflix was not willing to meet some of the subscription-based videos on demand (SVOD) service requirements applicable to the company [14]. This company also blocks the Telegram website because of the orders given by the Indonesian government [15].

Sampling in this study is a company in Jakarta. The variables used in this study are Security Education and Training (SET), Information Security Awareness (ISA), Employee Relationship (ER), Employee Accountability (EA), Organizational Culture (OC), And National Culture (NC) to test its effect on employee security behavior.

II. METHOD

A. Research Model
The following is the research model used:
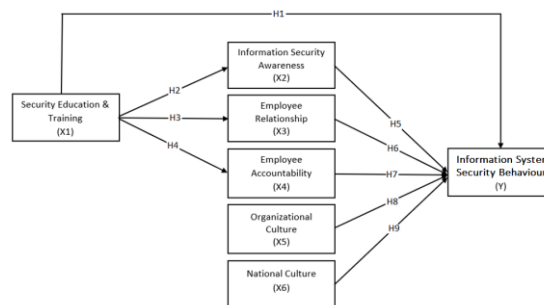
Figure 6 Research Model

The research model in figure 6 is a modification of the three previous research models, namely from Yaokumah et al., Connolly et al.. Connolly et al. Hypothesis 1, Hypothesis 3, Hypothesis 4, Hypothesis 6, and Hypothesis 7 were adopted from the model of Yaokumah et al. Hypothesis 2 and Hypothesis 5 were adopted from the model of Connolly et al. Meanwhile, Hypothesis 8 and Hypothesis 9 were adopted from the model of Connolly et al.

B. Hypothesis
Some hypotheses that can be formulated are as follows:

- H1: Security Education & Training significantly influences Information System Security Behavior.
- H2: Security Education & Training significantly affects Information Security Awareness.
- H3: Security Education & Training significantly affects Information Employee Relationship.
- H4: Security Education & Training significantly affects Employee Accountability.
- H5: Information Security Awareness significantly influences Information System Security Behavior.
- H6: Employee Relationship has a significant influence on Information System Security Behavior.
- H7: Employee Accountability significantly influences Information System Security Behavior.
- H8: Organizational Culture significantly influences Information System Security Behavior.
- H9: National Culture significantly influences Information System Security Behavior. Equations

C. Variable Measurement
In measuring variables, indicators are needed to test the validity of these variables. The indicators obtained are based on three journals in the research model. They will be used to develop questions that are compiled into a questionnaire that will be distributed to respondents [16].

D. Data collection technique
The measurement in this study will use a Likert scale where data is collected from the results of a

questionnaire survey which is distributed using a google form and distributed to employees at an IT company in Jakarta.

E. Data analysis

The analytical method used in this research is Structural Equation Modeling (SEM) using SmartPLS 3 software. [17].

- *Measurement Model*

    Because the data collection in this study used a questionnaire, it is necessary to have a measuring tool to determine validity and reliability. A validity test is a form of testing the quality of primary data to measure the validity of a question in research. At the same time, the reliability test is a tool to measure a questionnaire which is an indicator of a variable or constructs. A questionnaire is said to be reliable or reliable if someone's answers are consistent with the questions [18].

    The validity test consists of two types: the convergent validity test and the discriminant validity test. The convergent validity test can be done in several ways, including by looking at the loading factor value on each indicator, whose value must be greater than 0.7 or through the Average Variance Extracted (AVE) value on each variable value must be greater than 0.5.

    The reliability test can be done by calculating the Cronbach's Alpha and Composite Reliability value. The test is reliable if the Cronbach's Alpha value is above 0.6 and the Composite Reliability value is above 0.7.

III. RESULTS AND DISCUSSINS

A. Previous Research

The research model used is a modification of the three previous research models.

- SETA significantly impacts security behaviour through monitoring, ER, and EA [19].
- The journal Employee Security Behaviour shows that security procedures such as rules and education impact employees' awareness to behave obediently [20].
- The journal Investigation of Employee Security Behavior investigates security precautions and cultural factors against employee security behaviour [21].
- The journal Managing Employee Compliance with IS Policies discusses three variables: Top Management, Organizational Behavior, and Theory of Planned Behavior [22].
- The journal The Influence of Organisational Culture and Information Security Culture on Employee Compliance Behavior discusses the combined influence of OC and information security culture [23].

B. The Convergent Validity Test

An indicator must represent one latent variable and underlie the latent variable. For this reason, a convergent validity test is needed. The convergent validity test can be done in several ways, including looking at the loading factor value, which is the value generated by each indicator to measure the variable, or the Average Variance Extracted (AVE) value. In this study, the loading factor value must be greater than 0.7, and the Average Variance Extracted (AVE) value must be greater than 0.5. This value describes adequate convergent validity, which means that one latent variable can explain more than half of the variance of its indicators on average.

- H1: Security Education & Training significantly influences Information System Security Behavior.

    Values of Outer Loadings: There is still a loading factor value smaller than 0.7, namely SET1 with a value of 0.306, SET2 with a value of 0.268, and SET3 with a value of 0.247 and Cronbach's Alpha Value: there are still Average Variance Extracted (AVE) values smaller than 0.5, such as latent variable 1.

- H2: Security Education & Training significantly affects Information Security Awareness.

    Values of Outer Loadings: there is still a loading factor value smaller than 0.7, namely SET4 with a value of 0.473 and Cronbach's Alpha Values: it can be seen that latent variable one and latent variable 2 have an AVE value greater than 0.5.

- H3: Security Education & Training significantly affects Information Employee Relationship.

    Values of Outer Loadings: There are still loading factor values smaller than 0.7, namely ER4 with a value of 0.636, SET1 with a value of 0.553, SET2 with a value of 0.431, and SET3 with a value of 0.431. Value 0.454 and Cronbach's Alpha Values: there are still AVE values smaller than 0.5, such as latent variable 1.

- H4: Security Education & Training significantly affects Employee Accountability.

    Values of Outer Loadings: there is still a loading factor value smaller than 0.7, namely EA3 with a value of 0.592 and SET4 with a value of 0.454 and Cronbach's Alpha Values: the AVE values of latent variable one and latent variable 2 are more significant than 0.5.

- H5: Information Security Awareness significantly influences Information System Security Behavior.

    Values of Outer Loadings: there is still a loading factor value smaller than 0.7, namely ISSB2 with a

value of 0.685 and Cronbach's Alpha Values: latent variable one and latent variable 2 have an AVE value greater than 0.5.

- H6: Employee Relationship significantly influences Information System Security Behavior.

    Values of Outer Loadings: there are still loading factor values smaller than 0.7, namely ER4 with a value of 0.349 and ISSB1 with a value of 0.455 and Cronbach's Alpha Values: latent variable one and latent variable 2 have an AVE value greater than 0.5.

- H7: Employee Accountability significantly influences Information System Security Behavior.

    Values of Outer Loadings: there are still loading factor values smaller than 0.7, namely EA3 with a value of 0.697 and ISSB2 at 0.542 and Cronbach's Alpha Values: it can be seen that latent variable one and latent variable 2 have an AVE value greater than 0.5.

- H8: Organizational Culture significantly influences Information System Security Behavior.

    Values of Outer Loadings: there is still a loading factor value smaller than 0.7, namely OC1 with a value of 0.642 and Cronbach's Alpha Values: latent variable one and latent variable 2 have an AVE value greater than 0.5.

- H9: National Culture significantly influences Information System Security Behavior. Equations

Values of Outer Loadings: there are still loading factor values smaller than 0.7, namely ISSB2 with a value of 0.683, NC1 with a value of 0.100, NC2 with a value of 0.606 and Cronbach's Alpha Values, and there are still AVE values smaller than 0.5, such as latent variable 1

C. The Discriminant Validity Test

The result of the Fornell-Larcker Criterion on each variable. That there are two variables whose correlation value on the variable itself is smaller than with other variables, the NC variable with a value of 0.670 and OC with a value of 0.753. Meanwhile, other variables have the most significant correlation value with themselves.

Discriminant validity test based on cross-loadings values. All EA variable indicators have the most significant cross-loadings value (0.735-0.854) in EA constructs. All ER variable indicators have the most significant cross-loadings value (0.629-0.903) in the ER construct. ISA variable indicators have the most significant cross-loadings value (0.715-0.884) in ISA constructs. All ISSB variable indicators have the most significant cross-loadings value (0.661-0.825) in the ISSB construct. The NC variable has one small cross-loadings value in the NC construct, namely the NC1 indicator with a value of -0.072. Meanwhile, the other two indicators have the most significant cross-loading values in NC construction, with values of 0.733 and

0.898. All OC variable indicators have the most significant cross-loadings value (0.656-0.855) in OC constructs. The SET variable has one small cross-loadings value in the SET construct, namely the SET4 indicator with a value of 0.484. Meanwhile, the other three indicators have the most significant cross-loading values in the SET construct with values of 0.732, 0.811, and 0.831.

D. The Reliability Test

Reliability test results can be said to be reliable if Cronbach's Alpha value is above 0.6 and the composite reliability value is above 0.7. Here are the results of reliability tests based on Cronbach's Alpha and Composite Reliability.

- The reliability test result is based on Cronbach's Alpha values on hypotheses 1, 2, 3, and 4. All variables, namely EA, ER, ISA, ISSB, and SET, can be reliable because Cronbach's Alpha values are more than 0.6, namely 0.816, 0.822, 0.827, 0.629, and 0.689.

- The result of a reliability test based on composite reliability values in hypotheses 1, 2, 3, and 4. EA, ER, and ISA variables can be said to be reliable because the Composite Reliability value is more than 0.7. Meanwhile, the ISSB and SET variables are unreliable because the Composite Reliability value is smaller than 0.7.

- The reliability test result is based on Cronbach's Alpha value in hypothesis 5. The ISA and ISSB variables can be said to be reliable because the value of Cronbach's Alpha is more significant than 0.6.

- The reliability test result is based on the Composite Reliability value in hypothesis 5. Isa and ISSB variables can be said to be reliable because the Composite Reliability value is more than 0.7.

- The reliability test result is based on Cronbach's Alpha value in hypothesis 6. The ER and ISSB variables can be said to be reliable because Cronbach's Alpha value is more significant than 0.6.

- The reliability test result is based on the Composite Reliability value in hypothesis 6. ER and ISSB variables can be said to be reliable because the Composite Reliability value is more than 0.7.

- The reliability test result is based on Cronbach's Alpha value in hypothesis 7. The EA and ISSB variables can be said to be reliable because Cronbach's Alpha value is more significant than 0.6.

- The reliability test result is based on the Composite Reliability value in hypothesis 7. EA and ISSB variables can be said to be reliable because the Composite Reliability value is more

- The reliability test result is based on Cronbach's Alpha value in hypothesis 8. The ISSB and OC variables can be said to be reliable because Cronbach's Alpha value is more significant than 0.6.
- The reliability test result is based on the Composite Reliability value in hypothesis 8. ISSB and OC variables can be said to be reliable because the Composite Reliability value is more than 0.7 The reliability test result is based on Cronbach's Alpha value in hypothesis 9. The ISSB variable can be said to be reliable because Cronbach's Alpha value is more significant than 0.6. Meanwhile, the NC variable is not said to be reliable because Cronbach's Alpha value is smaller than 0.6
- The reliability test result is based on the Composite Reliability value in hypothesis 9. The ISSB variable can be said to be reliable because its Composite Reliability value is more than 0.7. Meanwhile, the NC variable is unreliable because the Composite Reliability value is smaller than 0.7.

E. *Evaluasi Coefficient of Determination (R2)*

The result of the evaluation of the coefficient of determination, where it can be concluded that:

- SET affects EA by 0.485 with an adjusted value of R Square of 0.466. From these results, SET affects EA by 0.466 or 46.6%, and the influence of SET on EA is moderate.
- SET affects the ER by 0.300 with an adjusted value of R Square of 0.275. From these results,
- SET affects the ER by 0.275 or 27.5%, and the influence of SET on ER is moderate.
- SET affects the ISA of 0.586 with an adjusted value of R Square of 0.571. From these results, SET affects the ISA by 0.571 or 57.1%, and the effect of SET on ISA is strong.
- SET, ISA, ER, EA, OC, and NC affect ISSB by 0.729 with an adjusted value of R Square of 0.659. From these results, SET, ISA, ER, EA, OC, and NC affect ISSB by 0.659 or 65.9%, and tthe influence of SET, ISA, ER, EA, OC, and NC on ISSB is strong.

F. *The Hypothesis Test*

Hypothesis analysis is carried out using bootstrapping methods. The significance level used is 5% (0.05), which means that the relationship between variables is said to be significant if the p-values < 0.05.

Table 4. Hypothesis Test Results Using Bootstrapping

Variable Relationships	β	P-Values	Result
SET → ISSB	-0.061	0.939	No significant effect
SET → ISA	0.765	0.000	Significant effect
SET → ER	0.548	0.032	Significant effect
SET → EA	0.696	0.003	Significant effect
ISA → ISSB	-0.371	0.245	No significant effect
ER → ISSB	0.018	0.936	No significant effect
EA → ISSB	0.340	0.415	No significant effect
OC → ISSB	0.359	0.276	No significant effect
NC → ISSB	0.566	0.054	No significant effect

Table 4 is the result of a hypothesis test using the bootstrapping method. The results of the hypothesis test are based on the following p-values:

- Hypothesis Analysis 1 (H1)
  The hypothesis 1 (H1) test results, namely the influence of the Security Education & Training variable on Information System Security Behavior, obtained a p-value of > 0.05, which is 0.939. Thus, H1 was declared rejected.
- Hypothesis 2 (H2) Analysis
  The results of hypothesis 2 (H2) test, namely the influence of the Security Education & Training variable on Information System Awareness, obtained a p-value of < 0.05, which is 0.000. Thus, H2 is declared accepted.
- Hypothesis Analysis 3 (H3)
  In hypothesis 3 (H3) test results, the influence of the Security Education & Training variable on the Information Employee Relationship obtained a p-value of < 0.05, which is 0.032. Thus, H3 is declared accepted
- Hypothesis Analysis 4 (H4)
  The hypothesis 4 (H4) test results, namely the influence of the Security Education & Training variable on Employee Accountability, obtained a p-value of > 0.05, which is 0.003. Thus, H4 is declared accepted.
- Hypothesis Analysis 5 (H5)
  The results of hypothesis 5 (H5) test, namely the influence of the Information Security Awareness variable on Information System Security Behavior, obtained a p-value of > 0.05, which is 0.245. Thus, H5 is declared rejected.
- Hypothesis Analysis 6 (H6)

The hypothesis 6 (H6) test results, namely the influence of employee relationship variables on Information System Security Behavior, obtained a p-value of > 0.05, which is 0.936. Thus, H6 was declared rejected.

- Hypothesis Analysis 7 (H7)

  The results of hypothesis 7 (H7) test, namely the influence of the Employee Accountability variable on the Information System Security Behavior, obtained a p-value of > 0.05, which is 0.415. Thus, H7 was declared rejected.

- Hypothesis Analysis 8 (H8)

  The hypothesis 8 (H8) test results, namely the influence of the Organization Culture variable on the Information System Security Behavior, obtained a p-value of > 0.05, which is 0.276. Thus, H8 was declared rejected.

- Hypothesis 9 (H9) Analysis

  The results of the hypothesis 9 (H9) test, the influence of National Culture variables on Information System Security Behavior, obtained a p-value of > 0.05, which is 0.054. Thus, H9 was declared rejected.

IV. CONCLUSION

This study aims to determine what factors influence Information System Security Behavior or employee behavior at IT companies in Jakarta in using company information systems, both factors that influence directly or indirectly (mediated). The conclusions that can be drawn from this research are:

- The National Culture variable is the variable that most influences Information System Security Behavior because it has the most significant value of 0.054, meaning that every increase in the value of the National Culture variable by one unit will increase the value of the Information System Security Behavior variable by 56.6%, assuming other variables is a fixed value.

- Security Education & Training variable has a significant effect on Information System Awareness following the theoretical implications in the last journal, where education, training, and information security awareness are three interrelated organizational activities to encourage employee understanding and compliance with information security and policies. Guidelines.

- Security Education & Training variable has a significant effect on Employee relationships, following the theoretical implications in the last journal, where there is a significant relationship between the Employee Information Security Education & Training variable and the development of Employee relationships.

- Security Education & Training variable has a significant effect on Employee Accountability,

following the theoretical implications in the last journal where there is a significant relationship between Employee Information Security Education & Training and Employee Information Security Accountability.

The results of this study can practically be used as input for companies to pay more attention to education, training, and information security awareness of employees. This is because there has been a significant influence between the Security Education & Training variables on Information System Awareness, Employee Relationships, and Employee Accountability

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Adoption of SNI ISO/IEC 17025:2017 Principles for Laboratory Management Information System Development

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Abstract— **The Software Engineering and Information System Laboratory of Sriwijaya University is in charge of building a technology-based system, in accordance to the strategic objectives of Sriwijaya University which prioritizes the principles of Good governance. To support laboratory operations, a management information system is needed to improve efficiency in planning, managing and reporting. The purpose of this research is to develop a laboratory management information system that adheres to the principles in the SNI ISO/IEC 17025:2017 standard. The software was developed using the Framework for the Application System Thinking (FAST). In the requirement analysis phase, an in-depth study was carried out to formulate requirements in accordance with the principles in the SNI ISO/IEC 17025:2017 clause control standard. In the end, a Laboratory MIS was successfully developed using this approach. Implementation of this system could increase the performance of the laboratory in providing better services and results by simplify the operational process, and shorten time consumption.**

Index Terms—*Laboratory Management Information System; FAST Method; SNI ISO/IEC 17025:2017; Good Governance; Higher Education;*

I. Introduction

Information technology has become one of the breakthroughs in the success of an organization, but the absence of good IT governance will cause new burdens or problems on the organization [1]. Therefore, IT governance management is needed so that the technology that has been developed can be used and managed properly[8]. Technological developments also have an impact on Sriwijaya University, as a university that prioritizes good governance in every line of service. By following the era of technology 4.0, Sriwijaya University hopes to realize its strategic goal of becoming a university that improves the quality of learning and student affairs, the quality of institutions, increases research and development productivity, as

well as the realization of Good governance in all Sriwijaya University environments towards a World Class University. So it is very necessary to implement an information technology-based management system in every business[6].

The Software Engineering and Information System Laboratory of Sriwijaya University is in charge of building a technology-based system, this task is based on the strategic objectives of Sriwijaya University which prioritizes the principles of Good governance. To support laboratory operations, a management information system is needed to improve efficiency in planning, managing and reporting. In order for the quality of this laboratory to be recognized, a standardization that covers many aspects and various requirements is needed[7].

The SNI ISO/IEC 17025:2017 standard is an accreditation standard for testing and calibration laboratories used by laboratories that develop quality, administrative, and technical management systems to support laboratory operational activities[3].

The purpose of this research is to develop a laboratory management information system that adheres to the principles in the SNI ISO/IEC 17025:2017 standard. The software was developed using the FAST method. In the requirement analysis phase, an in-depth study was carried out to formulate requirements in accordance with the principles in the SNI ISO/IEC 17025:2017 clause.

II. Research Method

A. Research Model

Good Governance is what underlies the development of information systems in laboratories, which is in accordance with the principles of Sriwijaya University prioritizing Good Governance. Before developing the system, it is necessary to understand that Good Governance is the principle of corporate

governance that intends to improve the company's performance and have a good impact on the company.

Good governance is not only applied to a company but can also be applied by various agencies and organizations. In its implementation, Good Governance has several principles namely Transparency, Accountability, Participation, effectiveness and efficiency, Responsibility, and fairness [7]

B. SNI ISO/IEC 17025:2017

SNI ISO/IEC 17025:2017 was developed by the International Organization for standardization / International Electrotechnical Commission regarding the general requirements for the competence of testing and calibration laboratories, which is a reference for world-class laboratory standardization. In applying this standard, it is necessary to carry out tests to examine or determine the characteristics, content and parameters that determine the quality of a product, component in the laboratory [5]. In Indonesia, the institution that tests this standard is the National Accreditation Committee (KAN).

This standard has the aim of developing trust in the operation of laboratories and contains requirements to demonstrate that the laboratory operates implementing Good Governance principles and is impartial and that the laboratory can provide recognized results[4]. The management system requirements in SNI ISO/IEC 17025:2017 include the following Management system documentation, Management system document control, record control, Actions to overcome risks and take advantage of opportunities, Improvements, Corrective actions, Internal audits, and Management reviews.

C. Framework for the Application System Thinking (FAST)

The FAST (Framework for the Application System Thinking) development method is a system development method that identifies and analyzes problems, opportunities, obstacles that occur, and requests for expected needs to provide suggestions for improvement. The FAST method is a combination of various system development methods that are arranged into several more flexible processes, this FAST development method also has many advantages, including the ability to support good system development and is supported by various techniques[5].

In this study, system development was carried out using the Framework for the Application of System Thinking (FAST) method. FAST is a work structure that can adapt to any type of project. The FAST method can produce a system in minimum time with good quality. There are several stages that must be taken including the definition of scope, problem analysis, requirement analysis, logical design, decision analysis, physical design, construction and testing, and

implementation. Figure 1 shows the stages that are passed.

Framework for the **A**pplication **S**ystem **T**hinking
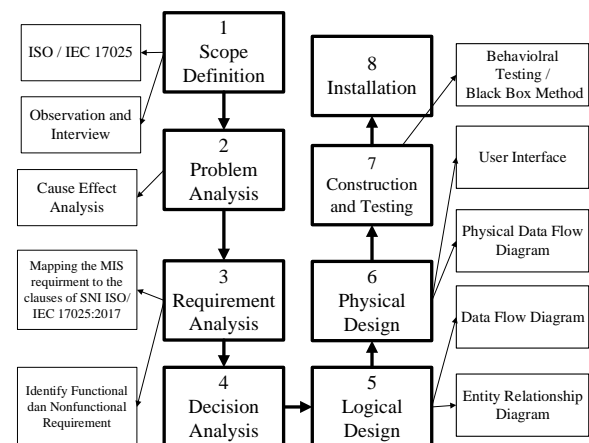
Fig 1. Research Method

III. RESULTS AND DISCUSSINS

A. Scope Definition

The software developed has the aim of facilitating all business processes that occur in the laboratory to be more effective, efficient, easy to monitor and control, in order to achieve good governance in the laboratory environment. With the presence of this system, it is desirable to be able to assist users in minimizing time on the previous system.

TABLE I. SCOPE DEFINITION

Business Goal	Project Goal
• Assist in managing laboratory data, users, inventory, laboratory use, and laboratory assistant attendance. • Accommodate reports of all business processes on a regular basis to the leadership/head of the laboratory. • Provide laboratory information to the public.	• Simplify all business processes that occur in the laboratory. • Minimize time in managing laboratory data.

B. Problem and Requirement Analysis

There are four problems have been identified, as following:
- Lack of information management of laboratory inventory items
- Monitoring and scheduling laboratory usage is difficult
- Laboratory assistant attendance management process is not efficient
- Preparation of laboratory reports requires a long process and time

A mapping of the problems encountered in the computer laboratory will be carried out with the clause in SNI ISO/IEC 17025:2017: 2017. Based on the problem analysis that has been done, it can be detailed the conditions that trigger problems in the laboratory as shown in Table II.

TABLE II.   THE PROBLEMS

ID	Description
A	Laboratory inventory data management is done manually
B	Laboratory inventory data is created only when needed (ad hoc)
C	laboratory inventory data that is managed in physical document (paper based) that has not been stored in the database
D	scheduling of laboratory usage is done manually
E	users must come to the lab admin room to find out the schedule
F	Information on laboratory usage schedules is difficult to access
G	laboratory assistant attendance is done manually
H	Assistant attendance data storage and recording is done conventionally
I	Attendance data is difficult to access
J	Monitoring of laboratory operational activities was not documented
K	Recapitulating the lab operational activity report take long time

The problems that have been identified are then seen for compliance with the recommendations for control standards according to SNI ISO/IEC 17025:2017. From a total of 35 clauses, Table III below is the clauses that are considered directly related which can be used as the basis for the functional requirements of the Laboratory Management Information System.

TABLE III.   CLAUSES OF SNI ISO/IEC 17025:2017

Clauses Number	Clauses Description
4.2	The laboratory must provide information to customers, if any information is published
5.5	establish structures, responsibilities, authorities, and document procedures (to the extent necessary) to maintain consistency
5.6	have personnel who (in addition to other duties and responsibilities) have the responsibility and authority to ensure the implementation, maintenance and improvement of the management system, identify deviations from the management system or from procedures for carrying out laboratory activities, initiate actions to prevent or minimize deviations, report to management laboratory related to management system performance and improvement
6.1	must have the necessary personnel, facilities, equipment, systems and supports to produce correct and reliable reports and/or certificates of test and/or calibration results.
6.3.2	Facility requirements that affect the performance of laboratory activities must be documented

Clauses Number	Clauses Description
6.4.1	must have access to the equipment (standards, measuring instruments, software, reference data, solvents, consumables, etc.)
6.4.4	must have procedures for handling, transport, storage, use and maintenance of equipment must verify that the equipment meets specified requirements before first use or upon reuse
6.4.13	shall have procedures for handling, transport, storage, use and maintenance of the equipment shall verify that the equipment complies with the specified requirements before first use or upon re-use, location of equipment, period of validity, maintenance plan, date of maintenance performed, details on breakdowns, malfunctions that have occurred or modifications that have been made
7.1.9	must cooperate with the customer or his representative in clarifying customer requests and in monitoring laboratory performance in carrying out the work requested by the customer
7.2.2	all methods, procedures and supporting documentation must be kept up-to-date and available for access
7.5.1	must maintain technical records made at the time of carrying out activities and given identification, for each laboratory activity containing results, reports, and sufficient information to contain the date and personnel responsible for laboratory activities, examination of data and results.
7.7	The laboratory must monitor its performance through comparison of results with other (external) laboratories, if the program is available and appropriate. This monitoring should be planned and reviewed
7.11	Data control and Information Management must have access to the necessary data and information. The information management system must be validated for functionality before use. the information management system must: be protected from unauthorized access, protected from tampering and loss, operated in an environment that meets the laboratory's or supplier's specifications, and for non-computerized systems, provide conditions that maintain the accuracy of manual recording and transcription; maintained in a manner that ensures the integrity of data and information; includes records of system failures and repairs as well as appropriate corrective actions instructions, manuals and reference data must be accessible to all relevant personnel
8.2	all documentation, processes, systems, records, relating to compliance with requirements must be included, referenced or linked to the management system of all personnel involved in

Then we mapped information on Table II to Table III, and we generate information as shown in Table IV below.

TABLE IV.   MAPPING PROBLEM TO SOLUTION BASED ON SNI ISO/IEC 17025:2017 CLAUSES

Problem ID	Proposed Solution based on SNI ISO/IEC 17025:2017 Clauses
A	4.2, 4.5, 5.6, 7.11, 8.2,
B	7.1.9, 7.11, 8.2,
C	6.3.2, 6.4.1, 7.2.2, 7.11
D	6.3.2, 6.4.1, 7.2.2, 7.11
E	7.1.9, 7.2.2
F	7.2.2,
G	5.6, 6.1, 6.3.2
H	6.3.2, 6.4.1, 7.2.2, 7.11
I	6.3.2, 7.2.2
J	6.3.2, 6.4.1, 7.2.2, 7.11
K	7.11, 8.2

After the problems that occur have been mapped according to the related control standards, then the functional requirements that must be provided by the software can then be formulated. We conclude that there are at least seven main features that the software should be able to run. Table IV describes the functional requirements and clauses in the referenced SNI ISO/IEC 17025:2017 control standard.

TABLE V.   FUNCTIONAL REQUIREMENT

Functional Requirement
Login page
Fiture of Data management (Lab Data and user data).
Laboratory Inventory management (C-R-U-D function).
Laboratory Utilization (C-R-U-D function) lab schedule, log book, and guest book.
Lab assistant attendance (CRUD function)
Laboratory Report generator
Public information provider (such as schedule, procedure, etc)

C. Logical and Physical Design

The following Figure 2 describes the business processes that run on the laboratory management information system at the software engineering laboratory and information systems at Sriwijaya University. There are 5 entities in this system, namely Lab administration, head of laboratory, laboratory assistant, chairman, and general user.
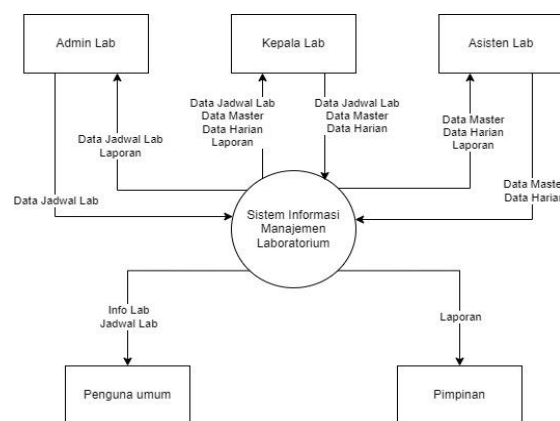
Fig 2. Proposed Context Diagram

Based on the existing context diagram, then explained further into Level-0 Data Flow Diagram (DFD). At this section, 5 processes are involved, namely login, "kelola data master" . "kelola jadwal lab", "kelola data harian", dan "laporan". This processes involves five entities and uses six database tables as show at Figure 3.
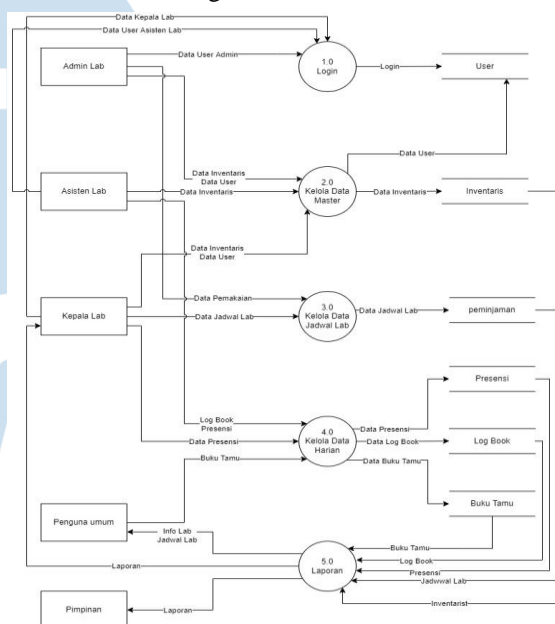
Fig 3. Proposed Level-0 DFD

Next we describe the subprocesses that existed as part of the previous Level-0 DFD. As for Figure 4, it describes the subprocess of "buku tamu", "log book", dan "presensi".
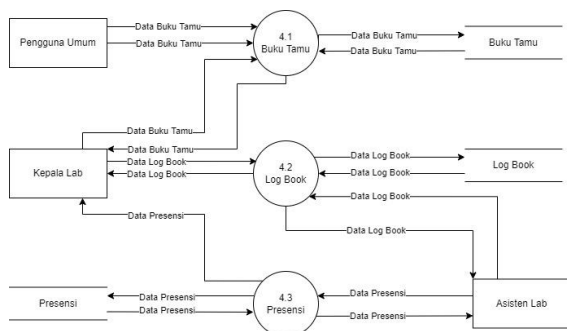
Fig 4. Proposed Level-1 DFD

Figure 5 describes the "jadwal kuliah" and "laporan" subprocess.
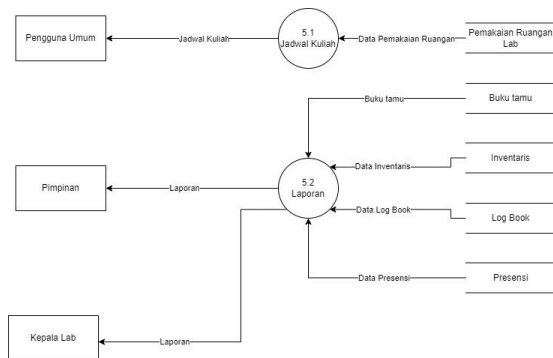
Fig 5. Proposed Level-1 DFD (2)

The next step, we tried to draw a Physical data flow diagram (PDFD). Physical data flow diagram (PDFD) is a depiction of a graph of the system used to define the flow of data from outside and into the system. Physical data flow diagrams do not describe what is going on but illustrate where, how and who is running the processes that occur in the system. Figure 6, Figure 7 and Figure 8 below are PDFDs that have been drawn.
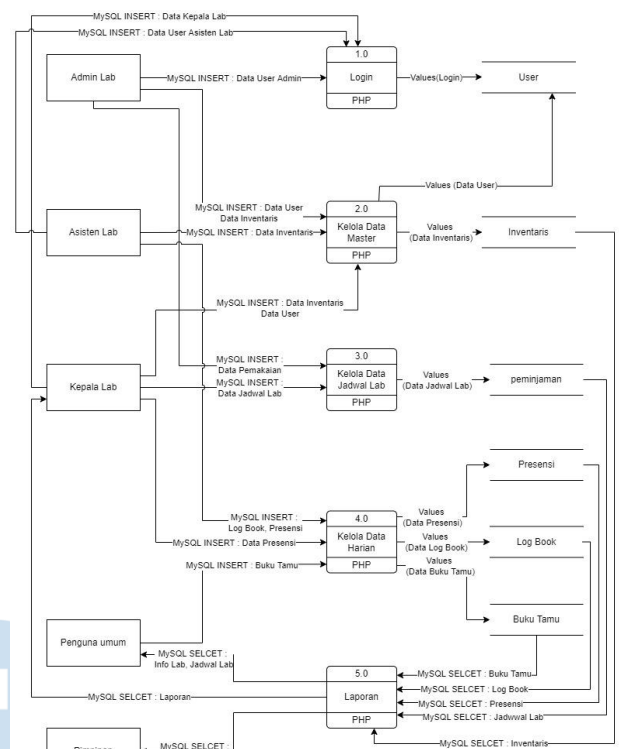
Fig 6. Proposed Level-0 Physical DFD
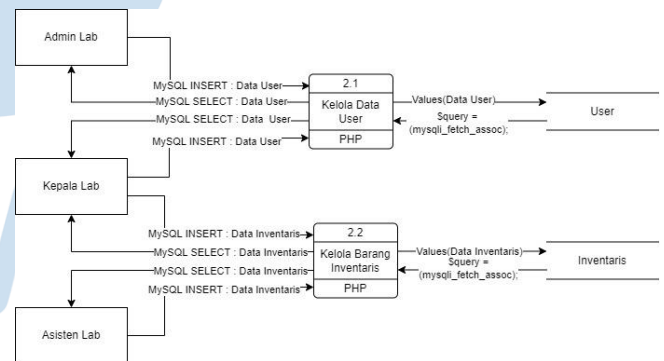
Fig 7. Proposed Level-1 Physical DFD (1)
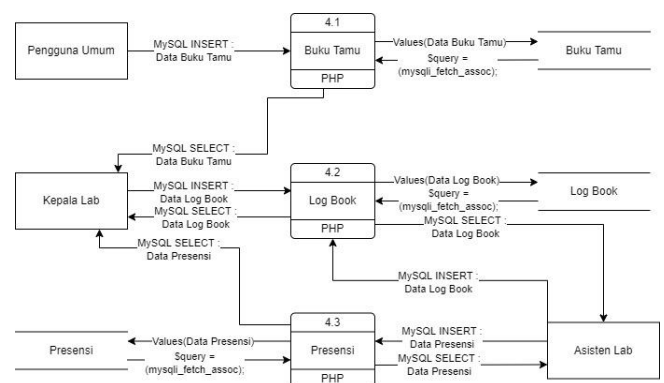
Fig 8. Proposed Level-1 Physical DFD (2)
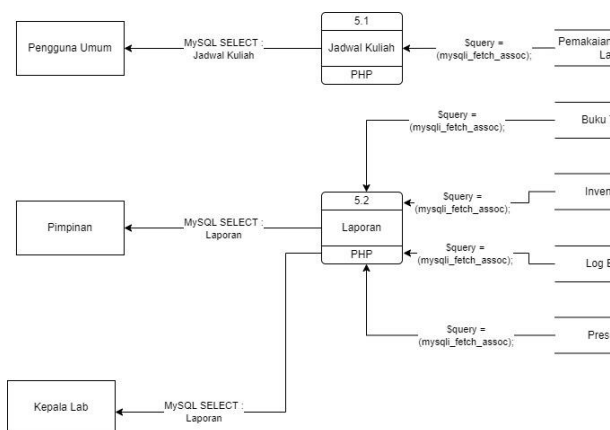
Fig 9. Proposed Level-1 Physical DFD (3)

Fig 11. Home Page

D. Construction, Testing and Installation

In this section, we begin to build the system construct that was designed in the previous session into code and executable software. Figure 10, Figure 11, Figure 12 and Figure 13 are the example of user interface has been made.

On Figure 10 there is a username and password that the user uses to access the system

On figure 12 the laboratory assistant can make attendance and also see the details of the presence that has been made.

Fig 12. Lab Assistant Attendance Page

In figure 13 the laboratory assistant and head of the laboratory fill out a list of activities that occur in the laboratory every day.
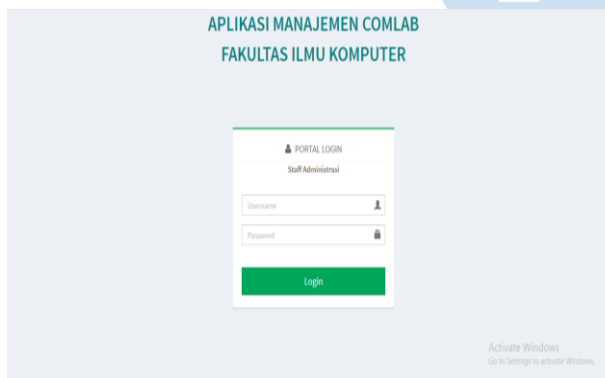
Fig 10. User Interface of Login Page

Fig 13. Log Book

On figure 11 the user will be greeted with a welcome word and information, on this page there is also a side bar main menu that is useful for selecting the features you want to use.
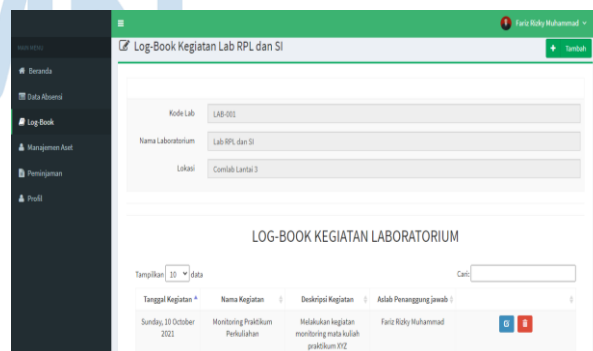
The software is then tested using the black box method. testing was carried out on seven functional features of the software as well as 52 test cases. The results obtained by the software were declared successful for all test cases, with a 100% success rate. The following are the results of black box testing on the laboratory management system:

TABLE VI.   TESTING BLACK BOX LOGIN.

Test case	Test procedure	Output	Conclusion
Login	Enter the correct email and password	Go to main page	Succeed
	Entered the wrong email and password	The system shows message "login failed"	Succeed
	Press the login button	Button can be pressed	Succeed

TABLE VII.   TESTING BLACK BOX USER DATA

Test case	Test procedure	Output	Conclusion
User data	Pressing the plus button on user data	Go to the add user data page	Succeed
	Pressing the cancel button on add user data	Exit page add user data	Succeed
	Fill in user data on add user data	Add user data column can be filled in	Succeed
	Pressing the Save button on add user data	User data can be retrieved and stored in the database	Succeed
	Pressing the edit button on the table in the user data	Go to the change user data page	Succeed
	Press the cancel button on change user data	Exit page change user data	Succeed
	Change user data on change user data	User data in the user data column can be changed	Succeed
	Pressing the Save button on change user data	User data can be retrieved and stored in the database	Succeed
	Pressing the delete button on user data	User data deleted from database	Succeed

TABLE VIII.   TESTING BLACK BOX INVENTORY DATA.

Test case	Test procedure	Output	Conclusion
Inventory data	Pressing the plus button on the inventory data	Go to the add inventory data page	Succeed
	Pressing cancel button on add inventory data	Exit page add inventory data	Succeed
	Filling inventory data on add inventory data	Add inventory data column can be filled	Succeed
	Pressing the Save button on add inventory data	Inventory data can be retrieved and stored in the database	Succeed
	Pressing the edit button on the table in the inventory data	Go to the change inventory data page	Succeed
	Press cancel button on change inventory data	Exit page change inventory data	Succeed
	Change inventory data on change inventory data	Inventory data in the inventory data column can be changed	Succeed
	Pressing the Save button on change inventory data	Inventory data can be retrieved and stored in the database	Succeed
	Pressing the delete button on the inventory data	Inventory data deleted from database	Succeed

TABLE IX. TESTING BLACK BOX LOAN DATA.

Test case	Test procedure	Output	Conclusion
Loan data	Pressing the plus button on the loan data	Go to the add loan data page	Succeed
	Pressing the cancel button on add loan data	Exit page add loan data	Succeed
	Fill in the loan data on add loan data	The column for adding loan data can be filled in	Succeed
	Pressing the Save button on add loan data	Loan data can be retrieved and stored in the database	Succeed
	Pressing the edit button on the table in the loan data	Go to the change loan data page	Succeed
	Menekan tombol batal pada ubah data peminjaman	Exit page change loan data	Succeed
	Change loan data on change loan data	Borrowing data in the loan data column can be changed	Succeed
	Pressing the Save button on change loan data	Loan data can be retrieved and stored in the database	Succeed

TABLE X. TESTING BLACK BOX PRESENCE DATA.

Test case	Test procedure	Output	Conclusion
Presence data	Pressing the fill presence button on the attendance data	Enter the presence data content page	Succeed
	Pressing the cancel button on the contents of the presence data	Exit the presence data content page	Succeed

	Fill in the presence data in the presence data content	The presence data field can be filled in	Succeed
	Pressing the Save button on the contents of the presence data	Presence data can be retrieved and stored in the database	Succeed
	Pressing the presence detail button on the table in the lab assistant data	Enter the presence data detail page	Succeed
	Pressing the print button on the presence data details	The system directly prints attendance data in excel form	Succeed
	Choose the month in the presence data you want to print	The presence data column can be selected according to the selected month	Succeed

TABLE XI. TESTING BLACK BOX LOGBOOK DATA.

Test case	Test procedure	Output	Conclusion
Logbook data	Pressing the plus button on the logbook data	Enter the add data logbook page	Succeed
	Pressing cancel button on add data logbook	Exit page add data logbook	Succeed
	Fill in logbook data on add logbook data	The column for adding logbook data can be filled in	Succeed
	Pressing the Save button on add logbook data	Logbook data can be retrieved and stored in the database	Succeed
	Pressing the edit button on	Go to the change	Succeed

	the table in the data logbook	logbook data page	
	Pressing cancel button on change logbook data	Exit page change logbook data	Succeed
	Change logbook data on change logbook data	Logbook data in the logbook data column can be changed	Succeed
	Pressing the Save button on change logbook data	Logbook data can be retrieved and stored in the database	Succeed
	Pressing the delete button on the logbook data	Logbook data deleted from database	Succeed

TABLE XII. TESTING BLACK BOX GUESTBOOK DATA.

Test case	Test procedure	Output	Conclusion
Guestbook data	Pressing the add button on the guestbook data	Go to the add guestbook data page	Succeed
	Pressing the cancel button on add guestbook data	Exit page add guestbook data	Succeed
	Fill in guestbook data on add guestbook data	The column for adding guest book data can be filled in	Succeed
	Pressing the Save button on add guestbook data	Guestbook data can be retrieved and stored in the database	Succeed
	Pressing delete button on guestbook data	Guestbook data deleted from database	Succeed

IV. CONCLUSION

The laboratory management information system at the Sriwijaya University software engineering laboratory and information system can be successfully created using the SNI ISO/IEC 17025:2017 approach to assist the software engineering laboratory and information system at Sriwijaya University in improving laboratory quality. It can also increase the performance of the laboratory in providing better services and results by simplify the operational process, and shorten time consumption.

ACKNOWLEDGMENT

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Finding Features of Multiple Linear Regression On Currency Exchange Pairs

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Abstract— **Due to the prospects for financial gain, forex is always attractive to many people. However, because forex market analysis is not simple, a computer is needed to assist in creating predictions using features that are understandable to people. This study employs the Multilinear Regression technique to identify these kinds of features. The features and prediction target have a very strong correlation with the lowest RMSE is 0.00408 and the highest R2 is 0.99477, the prediction quality is quite outstanding. The outcome will help academics in the forex field use machine learning algorithms to make better predictions.**

Index Terms—Features; Forex; Machine Learning; Multilinear Regression; Predictions;

I. INTRODUCTION

People trade for money by exchanging products for goods, goods for money, and, more recently, money for money. Forex trading is a type of trading in which one country's currency is swapped for another country's currency [1]. Not all currencies, however, are exchanged. EUR (European Union currency), GBP (British pound sterling), AUD (Australian Dollar), NZD (New Zealand Dollar), USD (United States Dollar), CAD (Canadian Dollar), CHF (Swiss franc), and JPY (Japanese yen) are the most widely traded currencies. Currency pairs are used in forex trading; for example, GBP and USD are coded as GBPUSD, EUR and USD are coded as EURUSD, and so on.

A Currency trader must have the knowledge and analytical capabilities of the transactions that take place in the forex market to generate a profit. If a trader takes a BUY action when the price rises, the trader will profit. Meanwhile, traders who take SELL actions will benefit as prices fall [2].

The currency market, on the other hand, is difficult to analyze [3]. This is since manual analysis is limited, but forex prices move in milliseconds. As a result, computers must assist humans in analyzing forex price fluctuations. Because the parameters utilized in the analysis may be no longer relevant in today's world.

The algorithmic trading approach is one way to undertake forex price analysis with the use of an algorithm [4]. Multiple Linear Regression is one of the algorithms employed in this strategy. Multiple Linear Regression is, in fact, an old algorithm. Even so, its capacity to explain which features influence prediction results, on the other hand, is undeniable [5]. This advantage will be used in this study to identify traits that are extremely useful in decreasing forex price forecast errors.

The opening price, the highest price, the lowest price, and the closing price are the four original prices that are used to express forex price fluctuations in Japanese candlesticks [6]. As a result, this research contributes to the discovery of traits that contribute significantly to the reduction of forex price forecast errors. The closing price is used for prediction in this study since it occurs at the end of each day's transaction.

The purpose of this study is to find features that are highly connected with prediction targets that are relevant to the current situation of the forex market and to reduce mistakes in forex price predictions. Whilst limitation of this study is other pairs that aren't limited to GBPUSD and EURUSD require more investigation. Only applies to feature groups, not to feature merging.
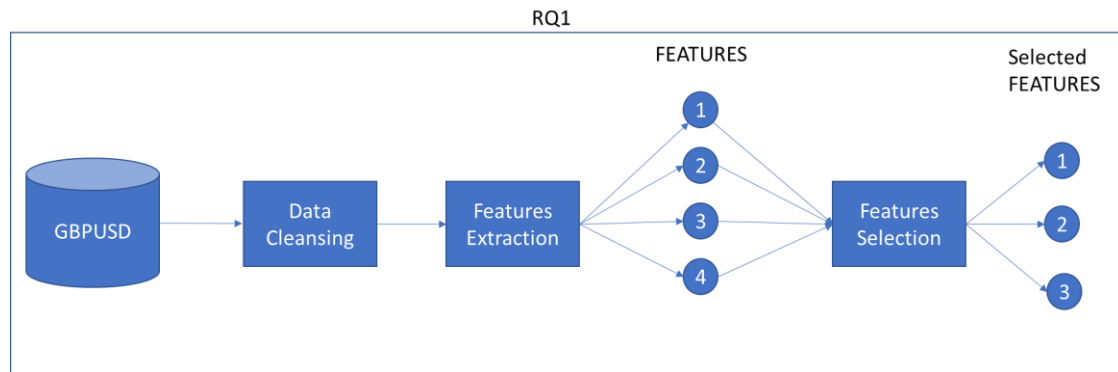
Fig. 1.   Data Preparation Process

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II.   LITERATURE STUDY

A. Multiple Linear Regression (MLR)

MLR is a method for predicting the dependent variable from a set of independent factors [7]. In this study MLR is applied to calculate today's close price based on some features ft+1, ft+2, ... fi while w0 is the intercept and coefficients wt+1, wt+2, … wi as shown on Equation 1:

$$C_t = w_0 + w_1 f_{t+1} + w_2 f_{t+2} \ldots w_i f_{t+i} \quad (1)$$

B. Correlation

The term "correlation" refers to the relationship that exists between two variables [8]. The correlation value might be anywhere from -1 to 1. The correlation is plus when the first variable is bigger than the second variable is also bigger. Whilst the negative sign means the opposite way. The correlation is stronger when the coefficient value is higher. Correlation can be calculated using the Equation 2:

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}} \quad (2)$$

MLR target variable close price is referred to as y in this study, and features f_1, f_2, … f_i. are referred to as x.

III.   RESEARCH METHODS

The Forex market is investigated. With a daily transaction of over US Dollars 6.59 trillion [9] the currency market is the largest in the financial world. The FX market is open five days a week, 24 hours a day. Because GBPUSD is a popular currency pair among forex traders, it is the currency pair of choice.

The CRISP-DM method is a data mining approach that is well suited for application in the industrial environment [10] This is evident in the Business Understanding module, where the first utility produced is a business problem of price prediction in the Forex market. It will be a near price forecast in the daily period if it is translated into a data analysis problem. The Data Understanding process begins with data collected from yahoo.finance.com, a popular financial data database supplier. The data was collected four years daily transactions from 2018 to 2021, to ensure that the research findings are still relevant to the status of the currency market.

The stages of the Data Preparation process are shown in Fig. 1 to answer RQ1. The data purification process is carried out at this point to see if any nulls remain. Because null data can cause mistakes in the program's results, it will be removed. Python was utilized in this study, and it is a popular data mining program nowadays. The close price is the variable utilized to calculate the prediction target. Where this price will be projected using a variety of alternative qualities that may be derived from the basic price of forex trading, namely the open, high, low, and close prices that have already occurred, starting with D-1, D-2, and so on. The feature must correlate with the close price of at least 95% to be selected. The goal of choosing a high correlation is to reduce prediction errors caused by mistakes in choosing predictive variables that are less connected with the close price.
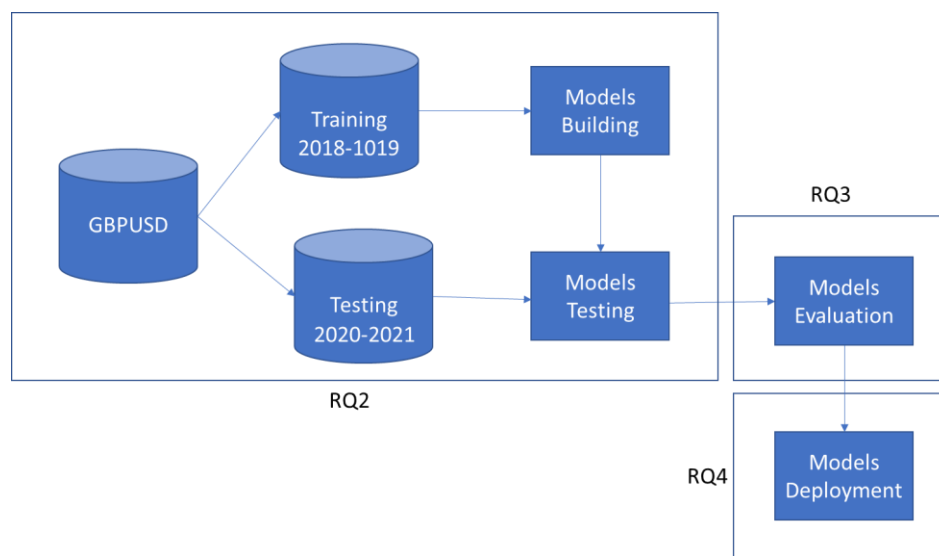
Fig 2. Research Processes From Models Buildings to Models Deployment

The MLR model was utilized. The high level of interpretation is an advantage of this method that is also a concern in this investigation. The MLR approach was chosen because it is more important to get features as well as to understand their contributions to daily close price predictions. After all, this research is still at the beginning of the process of discovering and reviewing features in forex prediction research. The data is split into two portions, training data, and testing data, using a 50:50 split to test the model. GBPUSD data from 2018 to 2019 is part of the training data. GBPUSD data from 2020 to 2021 was used in the testing. The Modeling to Deployment Process is depicted in Fig. 2 to answer RQ2 to RQ4.

The RMSE and R^2 units will be used to compare the prediction quality of each prediction model at the evaluation stage. The RMSE method is used to calculate prediction error in the hopes of reducing the error as much as possible by combining all highly linked information. R^2 is a metric for determining whether the forecast results and factual data are still linear in terms of the MLR algorithm. The higher the amount of linearity, the closer R^2 is to the value of 1. In this study, the optimal model is the one with the minimum RMSE and highest R^2. The best model will be evaluated at the deployment stage by applying it to data for a different currency pair, such as EURUSD. Because it is a widely traded currency pair in the forex market, this currency pair was selected.

Fig 3. Data Preparation Process GBPUSD Chart from 2028 to 2021

IV. RESULTS AND DISCUSSION

A. Business Understanding

Because forex trading only has four basic prices, the close price will be forecasted utilizing several features that can be derived from these four basic values. From Equation 1, when all features are zero, interception equals the value of the close price. If the features are not all zero, the contribution of each feature to the close price forecast will be visible in their corresponding weights.

B. Data Understanding

From 2018 through 2021, a popular financial website yahoo.finance.com was used to acquire GBPUSD statistics. As illustrated in Fig. 3, the price of GBPUSD began to rise in early 2018 and then began to fall until the first half of 2020. There was a drop in the first semester of 2020, followed by a strong increase. Of course, this is extremely helpful in determining the accuracy of the MLR prediction model. The data from 2020 to 2021 will be utilized as testing data, while the remaining data will be used as training data. Following that, the GBPUSD trend increased until the middle of 2021, before reversing till the end of 2021.

C. Data Preparation

To begin, search for data that is missing. Only on May 22, 2019, did there be no data. To avoid analysis problems, the data was then removed. After that, data is extracted from four different feature categories, including 5 prior daily closing prices, five previous daily original prices, Average prices, and Standard deviation of prices. Firstly, 5 prior daily closing prices. Close 1 (price closed yesterday), Close 2 (price closed two days ago), Close 3 (price closed three days ago), and so on until the fifth day ago are used to create this feature group. The limit has been set to 5 days ago, allowing users to use data for one trade week (five working days). These feature groups were chosen because they were all highly connected with a price that was within 96 percent of one another as shown in Fig. 4. The second feature group is Five previous daily original prices. This feature group is a more thorough version of the previous five daily closing prices feature groups. By including the four essential components of forex trading's basic pricing. Specifically, open 1, high 1, low 1, close 1 on one day ago, open 2, high 2, low 2, close 2 on two days ago, open 3, high 3, low 3, close 3 on three days ago, and so on till five days ago. All these feature groups were chosen because they had a very strong correlation at near prices, with a minimum correlation of 96 percent, as seen in the heatmap data. The next feature group is average prices. This feature group is generated using

the average formula, where average 2 is the average close price from one day to two days ago until average 5 is the average close price from one day to five days ago. This feature group was also chosen because it has a very strong association with.
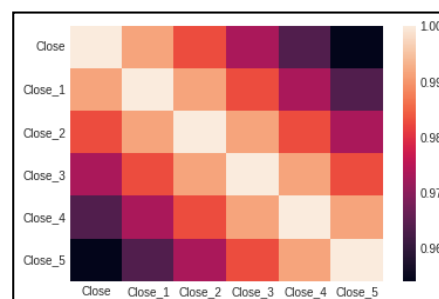
(a) Correlation Heatmap of 5 Previous Daily Closing Prices to Close
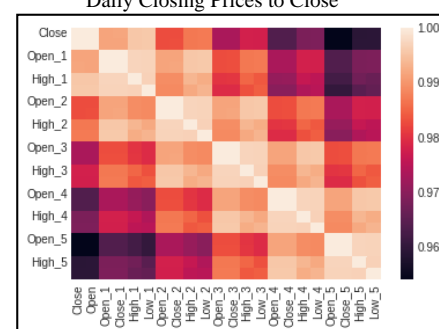
(b) Correlation Heatmap of 5 Previous Daily Original Prices to Close
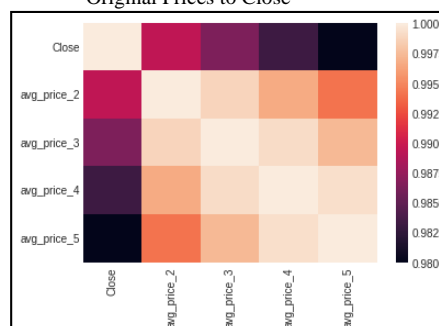
(c) Correlation Heatmap of Average Prices to Close
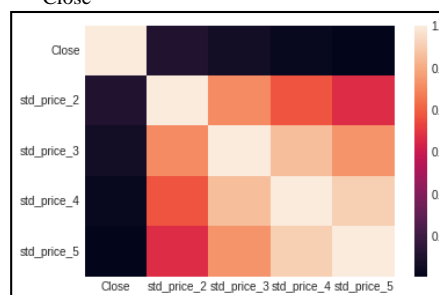
(d) Correlation Heatmap of Standard Deviation of Prices to Close

Fig 4. Feature Groups Heatmaps
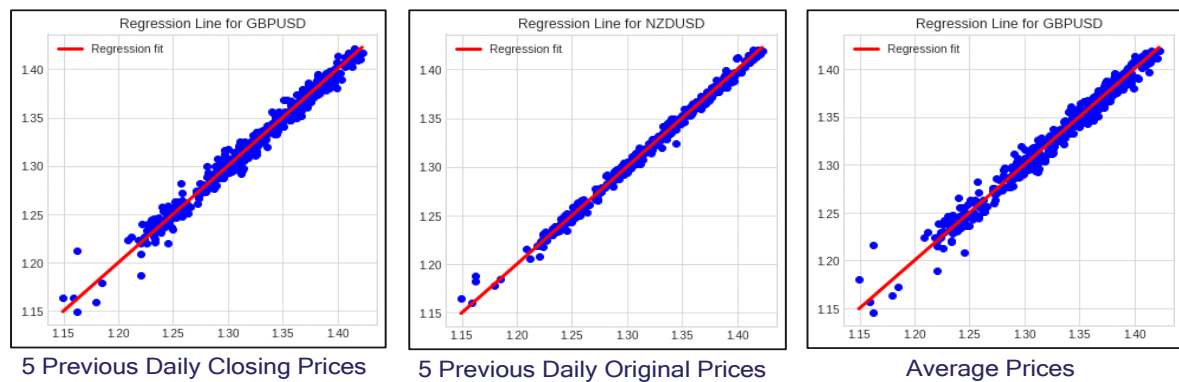
Fig 5. Data Preparation Process

close prices, with a minimum correlation of 98 percent. Because it takes at least 2 days to calculate the average, the Average Prices feature group starts from 2 days ago. The last feature group is the standard deviation of prices. Starting with the standard deviation 2 days ago and ending with the standard deviation 5 days ago.

The standard deviation feature group begins 2 days ago, as the average pricing group, because calculating the standard deviation takes at least 2 days. The standard deviation pricing feature group was not chosen based on the heatmap in Fig. 4, because it correlates with less than 95%.

D. Modeling

The modeling approach begins by dividing the data into training data from 2018 to 2019 and testing data from 2020 to 2021. The attributes that will be used for daily close price forecasts are calculated using training data. 5 prior daily closing prices, 5 previous daily original prices, and average prices are the three features chosen. The MLR Modeling program was then constructed using the Python program, which produces three models with the same name as the feature group. Afterward, the model is evaluated using data and quantified using RMSE and R^2.

E. Model Evaluation

The comparison of the three models as MLR models is shown in Fig. 5, by comparing their regression lines. Because the bulk of the forecast outcomes are quite close to or stick to their respective regression lines, the three models are very good at portraying the regression line. The three models reveal several residuals at the bottom when compared to nutritional volatility in the first half of 2020. The model with the 5 prior daily original prices features group has the best performance with the least amount of residual of these three models. A comparison of RMSE and R^2 will be used to further support these findings. As shown in Fig. 6, the RMSE model 5 previous daily original prices have the best performance, with an RMSE of 0.00408, as compared to the model 5 previous daily closing prices, which has an RMSE of 0.00736 and the Average Prices model, which has an RMSE of 0.00809. This is since the 5 prior daily original pricing model has a lower rate of forecast errors. Next, as shown in Fig. 7, Model 5 previous daily original pricing had the best performance, with $R^2 = 0.99477$ being the closest to 1. As a result, the best model in this investigation is the model using 5 previous daily original prices.

Fig 6. RMSE comparison among Three Feature Groups
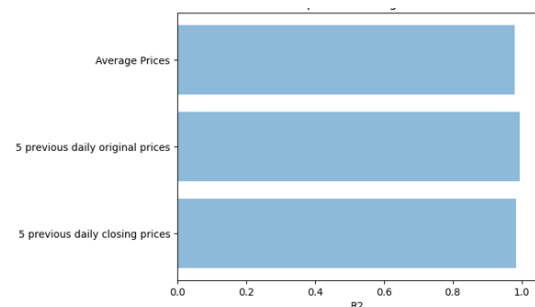
Fig 7. R^2 comparison among Three Feature Groups

able to maintain its shape when price swings occur, as they did in the first half of 2020.

5 Previous Daily Closing Prices   5 Previous Daily Original Prices   Average Price

Fig 8. Comparison of the Weights of the Features

The features analysis is then performed to illustrate the benefits and drawbacks of the five prior daily original pricing models as the winning model. Fig. 8 shows the comparison of the weights of the features used in each model's predictions. In comparison to the other two models, the winning model has more features. Although there isn't much of a difference between RMSE and R^2, adding characteristics will improve the prediction ability. Additionally, the winning model's weight distribution is more uniformly distributed, whereas the other models are dominated by attributes that are closer to the close price. It is necessary to have this steadiness to forecast the rise and fall of the GBPUSD price. The winning model's drawback is that, due to the numerous aspects involved, it is less

From Fig. 9, the truth of the GBPUSD closure price is compared to the three models' predictions of the GBPUSD close price. Overall, the truth map from 2020 to 2021 is excellent. Although there may be some variances, the three models can all map extremely well. The model with the 5 previous daily closing prices features group performs best in detecting price variations in the first half of 2020. This is since this model is more flexible because it just uses a single rule, namely the previous five days' close price. This model does not have as many features or prices as the other five daily original pricing models.

F. Model Deployment

Fig 9. Comparison of Truth and Multiple Linear Regression on GBPUSD using 5 previous daily original prices.

Fig 10. Data Preparation Process Comparison of Truth and Multiple Linear Regression
on EURUSD using 5 previous daily original prices.

The 5 previous daily original pricing models will now be tested on new data, specifically EURUSD, one of the most prominent currency pairings in the forex market. The overall findings at the time of the EURUSD truth mapping were still extremely good. This model still has prediction errors during price changes, as seen in Fig. 10 for EURUSD in the first half of 2020. The linearity of this model on EURUSD appears to be extremely good, as almost all forecast results are close to a linear line, with RMSE=0.00289, which is lower than the RMSE of this model on GBPUSD, and R^2=0.99538, which is higher than the R^2 of this model on GBPUSD. As a result, the EURUSD model's deployment process was effective, with even better results than the GBPUSD model.

V. CONCLUSION AND FUTURE STUDY

A. Conclusion

The 5 previous daily closing prices, 5 previous daily initial prices, and average prices can all be used to anticipate the daily closure of GBPUSD. These three feature groups were chosen because they have a strong relationship with the daily close price. Where the prediction has an extremely low error rate and nearly perfect linearity qualities. To build machine learning, the CRISP-DM approach is utilized, as well as extraction and feature selection, to create machine learning to predict daily close prices. The model was created using the Python language and the MLR algorithm on the GBPUSD currency pair. The best model is MLR with 5 prior

daily original pricing feature groups, where RMSE is the lowest and R2 is the highest. The deployment process was pronounced effective because the 5 prior daily original pricing models performed better in another currency pair, namely EURUSD than it did in the GBPUSD currency pair.

B. Future Study

This study will be extended to find more features using more algorithms to give more options before applying these features to the expert system. Another possible study is to extract not just features but also rules using classification algorithms.

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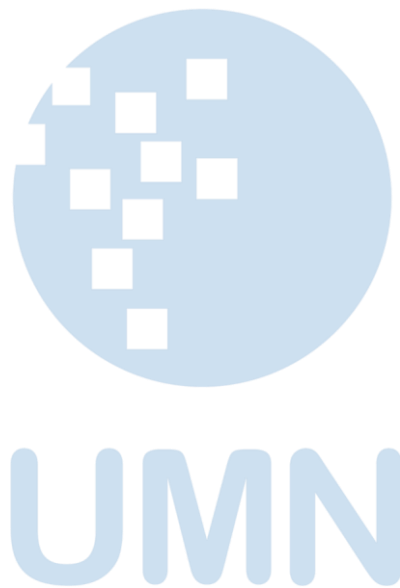
Aspect-Based Sentiment Analysis on Application Review using CNN

(Case Study : Peduli Lindungi Application)

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Abstract—As an obligatory application during the COVID-19 pandemic by Indonesians, PeduliLindungi must have provided outstanding quality services to its users. However, as of December 2021, users' sentiment toward the quality and service of the PeduliLindungi application was still low, with an application rating of 3.6 out of 5 on the Google Play Store. This study uses text mining techniques for the Aspect-Based Sentiment Analysis (ABSA) task in the PeduliLindungi application review, a sentiment analysis task based on the aspect category of the application. This study aims to classify the users' sentiment on aspects of the application and provide insight and knowledge to improve the quality of the PeduliLindungi application. The ABSA method used in this study is the classification of aspects and sentiments using the Convolutional Neural Network (CNN) algorithm. The results showed that the CNN model could produce such good performance with an f1 score of 92.23% in the aspect classification and 95.13% in the sentiment classification. The results of user sentiment modelling showed the dominance of negative sentiment in the eight aspects of the application, namely Visual Experience, Scan – Check-in/out, Vaccine Certificate, eHac, COVID Test, Register/Login, Performance and Stability, and Privacy, Data, and Security.

Index Terms—Aspect-Based Sentiment Analysis, Convolution Neural Network, PeduliLindungi, Text Classification, Text Mining.

I. INTRODUCTION

COVID-19 (Coronavirus Disease) first identified in Wuhan, China, in December 2019, has spread throughout the world until now [1]. In identifying cases and preventing the spread of the virus, many types of mobile applications have been developed. The first COVID-19 mobile application to be developed and widely published was an application for contact tracing created to notify users if they met another person infected with COVID-19 [2]. In Indonesia, the application developed to assist government in tracking to prevent the spread of COVID-19 is the PeduliLindungi application [3].

First released on March 28, 2020, the PeduliLindungi application has a tracking function by relying on community involvement to share location data to trace contact history with COVID-19 patients, patients under supervision, and people under supervision can be carried out.

Not only as a contact tracing application, PeduliLindungi also continues to grow and has many additional features. In September 2021, responding to the policy for the Implementation of Restrictions on Community Activities, commonly known as PPKM, the PeduliLindungi application became a mandatory application for public access, according to the rules in the Instruction of the Ministry of Home Affairs Number 42 of 2021 [4]. This rule has led to an increase in the use of the PeduliLindungi application.

As of December 2021, PeduliLindungi is the number 1 application in Indonesia in the medical category on the Google Play Store. It has been downloaded by more than 50,000,000 people and has a 3.6 out of 5 rates on the Google Play Store [5]. The rating is still relatively low, considering that PeduliLindungi, as an obligatory application, should provide excellent quality and service to its users.

Various reviews, as well as good and bad, are inevitable. However, this can be used to improve the quality of the application based on the analysis results from user reviews. By knowing the sentiments of aspect reviewed by users, developers can improve the quality of the relevant aspects of the application.

Sentiment analysis extracts sentiments, opinions, or judgments on products or services [6]. Most sentiment analysis is carried out at the sentence level, so it does not provide sufficiently important information for decision-making. However, this information can be obtained by conducting sentiment analysis at the sub-sentence level or aspect level [6].

If a reviewer reviews a product, the thing being reviewed relates to the aspects that exist in the product. It does not mean the reviewers like or dislike the

product as a whole, but in certain aspects. This concept sparked the Aspect-Based Sentiment Analysis (ABSA), which aims to discover people's sentiment about aspects of an entity [6]. The ABSA process is mainly done by classifying aspects and sentiments. The algorithm model used will classify the text into category aspects and then determine the sentiment [7].

Research conducted by [8] compared several deep learning algorithms in performing ABSA on hotel reviews with target classification aspects: price, hotel, room, location, service, restaurant, and sentiment classification: positive and negative. The study showed the CNN model algorithm has an accuracy of 90.4% for sentiment classification and 87.2% in aspect classification.

Researchers [9] compared the CNN algorithm model with Naïve Bayes in conducting ABSA on online marketplace reviews with target classification aspects: accuracy, quality, service, price, packaging, delivery, and sentiment classification: positive and negative. The CNN algorithm has a higher average accuracy of 91.98% for aspect classification and 93.07% for sentiment classification. No other journal sources are identical to the topic of ABSA for the Pedulilindungi application.

This research uses the CNN algorithm for the text classification task and aims to build the CNN model to classify aspects and sentiments on the PeduliLindungi application review, discover the model's performance, and compare the sentiment per an aspect of the application in versions 4.0.2 and 4.0.5.

In comparison to previous research, this research uses the Pedulilindungi application review as the research object. It will also classify unlabeled data using the CNN model built to compare the sentiments of each aspect sentiment on reviews of different application version. Both research conducted by [8] and [9] also used more general target classification aspects, such as quality, service, and price. Meanwhile, this research followed a series of aspect categories standards by Android and curated some aspects directly related to the function of the application content.

II. LITERATURE REVIEW

A. Text Mining

Text mining is a process of mining text data from an unstructured format to a structured format to identify existing patterns [10]. The main goal is to obtain and extract useful information from the text for use in further tasks. Text mining requires structuring the text used as input because it has an unstructured format. Therefore, text pre-processing must be carried out to clean and convert text into a structured format.

The pre-processing stages are divided as follows:
1) *Case Folding*

A common approach to deal with inconsistent capitalization in text is to generalize all characters by using the same letter, which is lowercase [11]. In addition, removing punctuation, numbers, extra spaces, and single characters is required to reduce noise.
2) *Tokenization*
Tokenization is breaking long sentence text into words, called tokens [10]. This process investigates each sentence and creates a list of tokens that can be used as input for the following algorithm [12]. The main objective is to investigate the words in a sentence [11].
3) *Normalization*
This process aims to normalize non-standard languages to the appropriate word in the KBBI.
4) *Filtering*
This process includes steps such as removing words with no information or are unnecessary (stop words). With this, the dimensionality of the text can be reduced without reducing the text content [12].
5) *Stemming*
This process aims to search for stem words by transforming words that have affixes or suffixes to the root words [12].

B. Aspect-Based Sentiment Analysis

Aspect-Based Sentiment Analysis, or ABSA, is a type of sentiment analysis that aims to determine sentiment in each specified aspect [8]. ABSA processes information at the sub-sentence level or aspect level.

In several studies, the process in ABSA is divided into two tasks, namely the task of aspect extraction and estimating the polarity/rating [6]. Aspect extraction aims to extract words/aspects from product reviews and group synonyms for each aspect because each person can use different phrases that refer to the same aspect [6]. The second task is polarity estimation which aims to determine the sentiment on an aspect, whether positive, negative, or neutral [6]. In this method, aspects are extracted first and then classified as positive or negative [13].

ABSA is also carried out in other method because the aspect extraction process requires a lot of resources [8]. The ABSA process can be done by classifying aspects and sentiments. The model used will classify text documents into category aspects and sentiment tendencies [7]. For example, in the review sentence "The food price is quite high", the ABSA model will classify the sentence into price aspects and negative sentiment classes [7]. This method requires labeled text data to train the model used in ABSA.

C. Convolutional Neural Network

Commonly used in computer vision and image processing, such as image classification and object detection, Convolutional Neural Network or CNN has been proven effective in Natural Language Processing (NLP) and has achieved good results in semantic text classification task [14].

The following is an explanation of each layer used on CNN for text classification task:

1) **Embedding layers**
This layer functions to map input in vocabulary indices into low-dimensional vectors [16]. The maximum sentence length determines the vocabulary size. After the words are transformed into vectors, it will be fed to the convolutional layer [15].

2) **Convolutional layers**
This layer is the main processing layer of the model, which carries out the convolution process for inputs and filters [9]. When the input enters this layer, a convolution operation involving a filter is applied to the word window to generate a new feature. The filter is applied repeatedly to each word window in the sentence to produce a feature map [14].

3) **Pooling Layer**
This layer gradually reduces the number of parameters, the computational complexity of the model, and control overfitting [16]. Max-over-time pooling is often applied to feature maps to retrieve the most important feature (feature with highest value) for each map [14].

4) **Fully-connected Layer or Dense Layer**
This layer forms one-dimensional neurons and consists of neurons interconnected with neurons in the previous and subsequent layers [9]. In this layer, regularization can be done with a dropout function to keeps the neurons in a probability value between 0 and 1, making it easier to classify output classes [17]. This layer will also output the specified number of classes using SoftMax activation.

III. METHODOLOGY

A. Overview of Research Object

The object of this research is user reviews on the PeduliLindungi application. PeduliLindungi is an application developed to help government agencies in tracking to prevent the spread of COVID-19 [3]. Since September 2021, PeduliLindungi has been an obligatory application for several activities and public access.

This study uses two application version reviews, namely versions 4.0.2 and 4.0.5. The selection of the application version is based on the amount of review data that is adequate for this study and adjusts the data collection period.

1) **PeduliLindungi Version 4.0.2**
PeduliLindungi version 4.0.2 was updated on October 19, 2021. The following is the list of the menus accessible to users in this version:
  - Vaccine Certificate
  - COVID-19 Test Results
  - E-Hac
  - Scan QR Code
  - Check-in History
  - Travel Regulations
  - Telemedicine
  - Healthcare Facility
  - COVID-19 Statistics
  - Get Vaccine
  - Account

2) **PeduliLindungi Version 4.0.5**
PeduliLindungi version 4.0.5 was updated on November 19, 2021. Several things are updated in this version, which listed on the PeduliLindungi page on Google Play, including:
  - Changes in the UI/UX.
  - Added Chinese, Japanese, Russian, Korean, and Spanish language options.
  - Improved flow of the E-Hac menu.
  - Added a CAPTCHA in certificate claim.
  - Added FAQ regarding zoning color status.
  - Eradication of bugs (errors).

B. Research Flow

The research flow used in this study is an adaptation of a research journal [7], [8] with several adjustments. The following is the steps that describes the flow of this research:
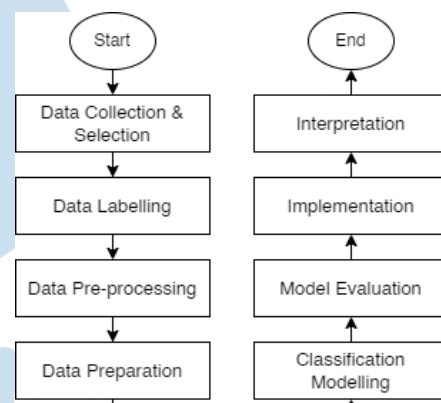
Fig. 1. Research Flow

a) **Data Collection and Selection**
The first step is to collect PeduliLindungi's review data from Google Play Store using the google_play_scraper library in Python, and then perform the data selection process.

b) **Data Labelling**
The next step is to manually label the review data for version 4.0.2 for the aspect and sentiment columns based on the review text. For aspect category, this research follows a series of aspect categories standards by Android, including Visual Experience (UI/UX), Functionality, Performance and Stability, and Privacy and Security [18]. For this research, the Functionality aspect will be expanded into features in the PeduliLindungi application. The aspect column has eight label targets, as shown in Table I. As for the sentiment, there are two

target labels, namely positive and negative sentiment, in Table II.

TABLE I.   ASPECT CATEGORIES

No	Aspect	Description
1	Visual experience (UI/UX)	The visuals of the application, user journey, content accessibility, and navigation.
2	Functionality – Scan QR, Check-in or Check-out	The function to check in or check out a place using QR scan, and location detection.
3	Functionality – Vaccine Certificate	The functions in the vaccine certificate menu.
4	Functionality – e-Hac	The functions in the e-Hac menu: to create, and view travel documents.
5	Functionality – COVID-19 Test	The functions in the COVID-19 test results menu.
6	Functionality – Register / Login	The application's ability to perform the registration and login into the application.
7	Performance and stability	The application's stability, performance (loads quickly, gives feedback to the user), and battery usage.
8	Privacy, Data, and Security	Access or permissions to support the applications, such as location permissions, accessing data, data storage, and the ability to display reliable data.

TABLE II.   SENTIMENT CATEGORIES

No	Aspect	Description
1	Positive	The reviews contain kind words, positive emotions, and support both implicitly and explicitly.
2	Negative	The reviews contain bad words, negative emotions, and do not support either implicitly or explicitly.

c) Data Pre-processing

At this stage, we clean the application review data in versions 4.0.2 and 4.0.5 and convert it from unstructured text data into structured ones.
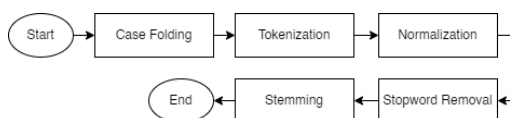
Fig. 2. Data Pre-processing Flow

d) Data Preparation

This stage is intended to prepare text data that is acceptable as the input of neural network.
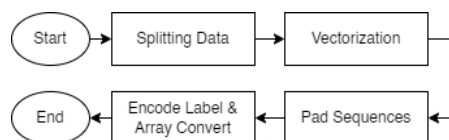
Fig. 3. Data Preparation Flow

e) Classification Modelling

Modeling is divided into two: modeling for aspect classification and sentiment classification. A separate CNN model will be created using parameters that show the best accuracy results in the hyperparameter tuning process. After initiating the model, training will be carried out using the data train.

f) Model Evaluation

We evaluate the model for its accuracy and loss using validation data at this stage. After that, we test the model using test data and evaluate the classification performance using metrics, namely accuracy, precision, recall, and F1 score.

g) Implementation

This stage aims to classify the unlabeled data (review version 4.0.5), using the CNN model for aspect classification and sentiment classification. The output is the classified aspects and sentiment of 4.0.5 review.

h) Interpretation

This stage aims to explain the results of the aspect and sentiment classification and compare the sentiments in each aspect on version 4.0.2 with version 4.0.5. The comparison is intended to determine whether the sentiment in each aspect significantly changed accordingly to the version update.

IV. RESULTS AND DISCUSSION

A. *Data Collection and Selection*

We collect the user reviews from Google Play Store using google_play_scraper. There are 2,320 reviews of version 4.0.2 and 1,031 reviews of version 4.0.5.

B. *Data Labelling*

Table III shows the example of review data of version 4.0.2 with its labeled aspect and sentiment.

TABLE III.   EXAMPLE OF REVIEW DATA

Review	Aspect	Sentiment
Hasil ehac beda swaktu dibuat, sudah diedit tetap gak berubah padahal butuh untuk terbang.	eHac	Negative
Checkin lambat, gak bisa baca QR, padahal udah nyalain GPS.	Scan, Checkin/out	Negative
Suka skali dngn update sekarang. Simpel dan color coded.	Visual Experience	Positive
Kerja bagus saya sudah bisa cek sertifikat vaksin.	Vaccine Certificate	Positive

The distribution of data labels, as seen in Table IV, shows the data is label imbalance. The aspect with the most reviews is Performance and Stability with 408 reviews, while lowest is the COVID-19 Test with only 73 reviews. Most reviews are negative sentiments with 1840 reviews and positive sentiment with 480 reviews.

TABLE IV.   ASPECT AND SENTIMENT LABEL DISTRIBUTION

Aspect	Positive	Negative	Total
Visual Experience	107	281	388
Scan, Checkin/out	71	336	407
Vaccine Certificate	87	248	335
eHac	17	94	111
COVID-19 Test	10	63	73
Register/Login	40	362	402
Performance and Stability	105	303	408
Privacy, Data, and Security	43	153	196
Total	480	1840	2.320

C. Data Pre-processing

This stage covers cleaning and converting unstructured text data into a structured format by filtering the terms of unnecessary things and normalizing them to a more uniform sequence. The result of data pre-processing is shown in Figure 4.

```
0    [tampil, dukung, buat, smartphone, rasio, layar, lama, tombol, agree, t...
1    [hasil, ehac, beda, waktu, buat, edit, kali, kali, tetap, ubah, padahal...
2    [sertifikat, vaksin, muncul, telepon, beberapa, kali, alas, sistem, sed...
3    [suka, sekali, update, sekarang, simpel, color, coded, bahkan, ibu, sul...
4    [checkin, susah, checkout, lebih, susah, aplikasi, bahkan, sering, mati...
Name: content, dtype: object
```
Fig. 4. Data Pre-processing Result

D. Data Preparation

We perform 4 steps in this stage, including:
a. Splitting Data
    We divide the review of version 4.0.2 into 70% train data, 15% validation data, and 15% test data with random_state of 42. Thus, 1.624 data trains, 348 validation data, and 348 test data.

b. Vectorization
    This stage aims to convert the text into a unique integer list form where each integer represents a unique word in the dictionary. Figure 5 shows the results of vectorization. The vocabulary size is 1.911, which indicates there are 1.911 unique words in the data.

```
Vocab size       : 1911
Original data    : buat ehac pilih airplane ubah jadi car terus
After vectorization: [9, 38, 81, 235, 73, 8, 162, 14]
```
Fig. 5. Vectorization Result of Review Data

c. Pad Sequences
    We transform each review to the same length so it can enter the neural network. The max sentence length parameter will determine how long each sequence is based on the longest sentence in the review data. To have the inputs with the same length, we fill the empty slot in the sequence with 0.

```
Max sentence length : 54
Original data       : buat ehac pilih airplane ubah jadi car terus
After vectorization and pad sequences:
[ 9 38 81 235 73  8 162 14  0  0  0  0  0  0  0  0  0
  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
```
Fig. 6. Pad Sequences Result on Review Data

d. Encode Label and Array Convert
    We perform the label encoding at this stage to convert the string type of aspect and sentiment label to a unique integer. The aspect label is then converted into a binary matrix.

E. Classification Modelling

1) Aspect Classification Modelling
    The CNN model in this study uses CNN sequential, with each layer stacked linearly from end to end. Each layer and parameter used can be seen in Table V.

TABLE V.   LAYER STRUCTURES OF ASPECT CNN MODEL

Layer	Specification
Embedding	Input_dim = 1.911 Output_dim = 150 Input_length = 54
Conv1D	Filters = 128 Kernel_size = 9 Activation = relu
GlobalMaxPooling1D	-
Dropout	Rate = 0.2
Dense	Units = 8 Activation = Softmax

We compile the aspect model using an Adam optimizer with a learning rate of 0.0001 and categorical cross-entropy for loss type.

```
Model: "sequential_1"

Layer (type)                  Output Shape           Param #
=================================================================
embedding_1 (Embedding)       (None, 54, 150)        286650

conv1d_1 (Conv1D)             (None, 46, 128)        172928

global_max_pooling1d_1 (Glob  (None, 128)            0

dropout_1 (Dropout)           (None, 128)            0

dense_1 (Dense)               (None, 8)              1032
=================================================================
Total params: 460,610
Trainable params: 460,610
Non-trainable params: 0
```
Fig. 7. CNN Model Initiation for Aspect Classification

We train the initiated aspect model using data train, while the validation process uses the validation data.

2) Sentiment Classification Modelling
    The sentiment classification model also uses CNN sequential. Each layer and parameter used can be seen in Table VI.

TABLE VI. LAYER STRUCTURES OF SENTIMENT CNN MODEL

Layer	Specification
Embedding	Input_dim = 1.911 Output_dim = 50 Input_length = 54
Conv1D	Filters = 128 Kernel_size = 3 Activation = relu
GlobalMaxPooling1D	-
Dropout	Rate = 0.2
Dense	Units = 1 Activation= Sigmoid

We also compile the sentiment model using an Adam optimizer with a learning rate of 0.001 and binary cross-entropy for loss type.

```
Model: "sequential_2"

Layer (type)              Output Shape          Param #
=================================================================
embedding_2 (Embedding)   (None, 54, 50)        95650

conv1d_2 (Conv1D)         (None, 52, 128)       19328

global_max_pooling1d_2 (Glob (None, 128)        0

dropout_2 (Dropout)       (None, 128)           0

dense_2 (Dense)           (None, 1)             129
=================================================================
Total params: 115,107
Trainable params: 115,107
Non-trainable params: 0
```

Fig. 8. CNN Model Initiation for Sentiment Classification

Then, we train the initiated sentiment model using data train, and the validation process uses the validation data.

F. Model Evaluation

1) Evaluate and Test Aspect Classification Model Figure 9 shows the accuracy and loss graph during the training and validation using the CNN model for aspect classification.
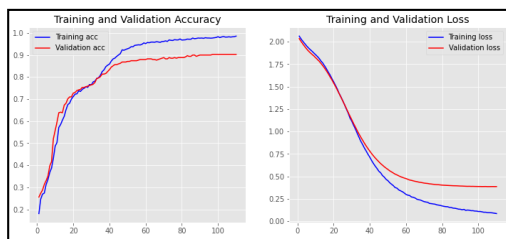

Fig. 9. Accuracy and Loss of CNN Model of Aspect

We can see the CNN model for aspect classification is well trained with training accuracy of 98.5% and validation accuracy of 90.2%. There is no overfitting indicated by the validation loss that continues to decrease in each epoch.

Then we apply the model into the test data to classify the aspect of the review. Figure 10 shows the confusion matrix of the aspect classification using test data.
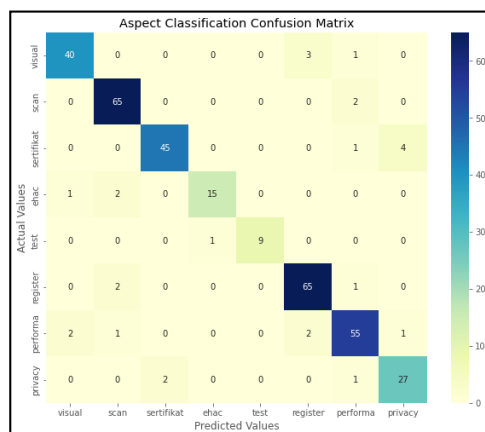

Fig. 10 Aspect Classification Confusion Matrix

The CNN aspect model got an overall accuracy of 0.9224, precision of 0.9234, recall of 0.9224, and f1 score of 0.9223. The performance of each

label can be seen in Table VII. The Scan Check-in or check-out aspect has the highest F1 score of 0.9489, while the aspect with the lowest F1 score is the Privacy, Data, and Security aspect with 0.8710.

TABLE VII.   ASPECT CLASSIFICATION REPORT

Aspect	Preci-sion	Recall	F1
Visual Experience	0.9302	0.9091	0.9195
Scan, Checkin/out	0.9286	0.9701	0.9489
Vaccine Certificate	0.9574	0.9000	0.9278
eHac	0.9375	0.8333	0.8824
COVID-19 Test	1.0000	0.9000	0.9474
Register/Login	0.9286	0.9559	0.9420
Performance and Stability	0.9016	0.9016	0.9016
Privacy, Data, and Security	0.8438	0.9000	0.8710
Accuracy		0.9224	

2) Evaluate and Test Sentiment Classification Model

Figure 11 shows the accuracy and loss graph during the training and validation of the CNN model for sentiment classification.
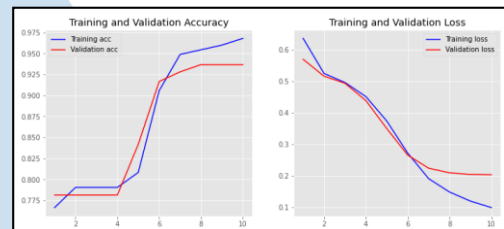
Fig. 11. Accuracy and Loss of CNN Model of Sentiment

The CNN model for sentiment classification is also well trained with a training accuracy of 97.4% and validation accuracy of 93.7%. Also, there is no overfitting indicated.

We apply the sentiment model into test data to classify the sentiment of the user review. Figure 12 shows the confusion matrix of the sentiment classification using test data.

Fig. 12. Confusion Matrix of Sentiment Classification

The CNN sentiment model got an overall accuracy of 0.9510, precision of 0.9514, recall of 0.9510, and f1 score of 0.9513. The performance of each label can be seen in Table

VIII. Negative sentiment has the highest F1 score of 0.97, while positive sentiment has an F1 score of 0.8682.

TABLE VIII. SENTIMENT CLASSIFICATION REPORT

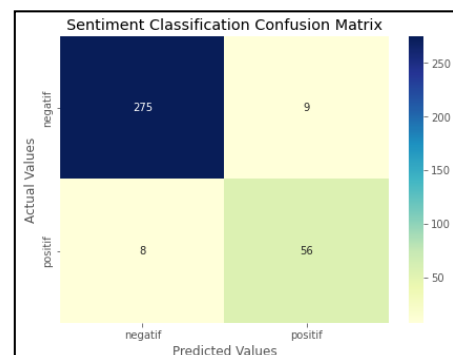| Sentiment	Precision	Recall	F1
Negative	0.9717	0.9683	0.9700
Positive	0.8615	0.8750	0.8682
Accuracy	0.9510		

G. Implementation

From the model evaluation, we concluded that the CNN model for both classification of aspects and sentiments has a good performance. After that, we perform the classification predictions to the unlabeled data using both CNN aspect and sentiment model.

	content	aspek	sentimen
0	mantap scan cepat sangat	b - Scan, Checkin/out	1
1	sesi habis maksud	f - Register/Login	0
2	download cek sertifikat vaksin bagus	c - Sertifikat Vaksin	1
3	captcha terlalu banyak susah mau login bedain mana robot mana bukan mem...	f - Register/Login	0
4	aplikasi sangat susah download sertifikat vaksin arah baru nik cek stat...	c - Sertifikat Vaksin	0
5	padahal sudah daftar kalau crash mau login nomor daftar	f - Register/Login	0
6	bug banyak captcha selalu salah data lambat masuk	g - Performance/Stability	0
7	susah banget buat klaim sertifikat sekarang ckkk	c - Sertifikat Vaksin	0
8	atur tanggal lahir ubah jadi ketik ribet mau tekan bas puluh tahun bela...	a - Visual Experience	0
9	website selalu gagal daftar nik aplikasi hadeh buat anak magang miskin ...	g - Performance/Stability	0

Fig. 13. Classified Aspect and Sentiment of 4.0.5 Review

Table IX shows the distribution of the classified aspects and sentiments on 4.0.5 application review.

TABLE IX. LABEL DISTRIBUTON OF CLASSIFIED 4.0.5 REVIEWS

Aspect	Positive	Negative	Total
Visual Experience	28	63	91
Scan, Check-in or check-out	12	141	153
Vaccine Certificate	17	177	194
eHac	1	18	19
COVID-19 Test	0	34	34
Register/Login	8	169	177
Performance and Stability	55	263	318
Privacy, Data, and Security	6	39	45
Total	127	904	1.031

H. Interpretation

Figure 14 compares sentiment in each aspect in versions 4.0.2 and 4.0.5, where red represents negative sentiment and blue represents positive sentiment.
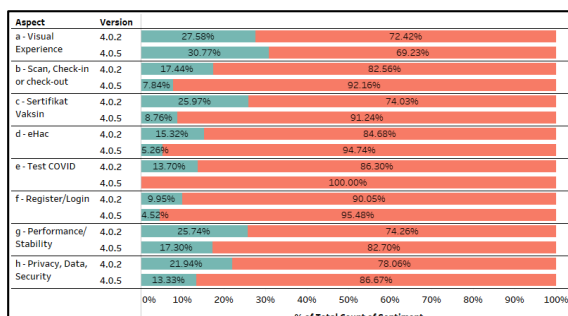

Fig. 14. Comparison of Sentiment in Each Aspects

User sentiment on both version of PeduliLindungi application is dominated by negative sentiment. Figure 15 shows that if we explored it per aspect, almost all the aspects experienced an increase in negative sentiment in version 4.0.5, except for the Visual Experience aspect.
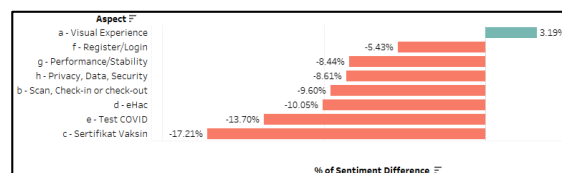

Fig. 15. Sentiment Percentage Difference in Version 4.0.2 to 4.0.5

Vaccine Certificate aspect experienced the highest increase in negative sentiment in version 4.0.5 by 17.21%. It was caused by an additional CAPTCHA that did not function well in claiming vaccine certificate; as in the review, "Setiap mau klaim sertifikat vaksin gak bisa, captcha ngulang terus" (every time (I) want to claim a vaccine certificate, it fails, the captcha keeps repeating).

The COVID-19 Test aspect also experienced an increase of 13.70% due to the number of test results that did not available in the application, such as in the review "Udah test PCR di RS AK Gani Palembang, tapi hasil di PeduliLindungi belum keluar padahal besok terbang" ((I) had a PCR test at the AK Palembang hospital, but the results PeduliLindungi have not been released, even though tomorrow (is the schedule to) fly).

Furthermore, the third-highest aspect is the eHac aspect, increasing 10.05% due to the eHac creation flow becoming more complex, as in the review "Pengisian eHac yang terbaru tidak praktis." (The latest (version of) eHac filling is impractical).

From the comparison between sentiment per aspect on version 4.0.2 and 4.0.5, it can be concluded that the application updates made an increase of negative sentiment in 7 aspects of the application. It is necessary to improve the PeduliLindungi application based on the cause. This analysis can also be used to prioritize aspects for corrective action in the following application update.

Research conducted by [8] and [9] has proven that CNN performs well for the ABSA task in classifying aspects and sentiments of user reviews. As for this research, we also performed the classification task to unlabeled data and compared each sentiment per aspect on different review per application version to expose whether an application update significantly changed the user's sentiment. Furthermore, this research's application of the CNN model gave better results with no overfitting indicated. The targeted aspects in this research will also give a better insight into the application usage since we use more detailed aspects than in the previous research.

V. CONCLUSION

This study performed good results of Aspect-Based Sentiment Analysis (ABSA) using CNN model on aspect classification and sentiment of review data. The results showed that the CNN model could produce such good performance with an f1 score of 92.23% in the aspect classification and 95.13% in the sentiment classification.

User sentiment on the eight aspects of the application: Visual Experience, Scan – Checkin/Out, Vaccine Certificate, eHac, COVID-19 Test, Register/Login, Performance and Stability, and Privacy, Data, and Security is dominated by negative sentiment. As for the application version 4.0.5, the sentiment given to each aspect increased in negative sentiment, except for the Visual Experience aspect.

In version 4.0.5, the Vaccine Certificate aspect increased 17.21% due to the CAPTCHA feature that did not function properly. It was then followed by COVID Test aspect by 13.70% due to the large number of test results not released in the application, and the eHac aspect of 10.05% due to the impractical flow of the eHac filling.

Since the performance of the CNN model in this study has proven to be good, it can be continued with the development of applications that will facilitate the monitoring of user sentiment on every aspect of the application review. For further research, exploration of word embedding options also can be carried out using pre-trained word embedding such as Word2Vec or Glove to improve the word representation with semantic meaning.

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AUTHOR GUIDELINES

1. Manuscript criteria

- The article has never been published or in the submission process on other publications.
- Submitted articles could be original research articles or technical notes.
- The similarity score from plagiarism checker software such as Turnitin is 20% maximum.
- For December 2021 publication onwards, Ultima Infosys : Jurnal Ilmu Sistem Informasi will be receiving and publishing manuscripts written in English only.

2. Manuscript format

- Article been type in Microsoft Word version 2007 or later.
- Article been typed with 1 line spacing on an A4 paper size (21 cm x 29,7 cm), top-left margin are 3 cm and bottom-right margin are 2 cm, and Times New Roman's font type.
- Article should be prepared according to the following author guidelines in this template. Article contain of minimum 3500 words.
- References contain of minimum 15 references (primary references) from reputable journals/conferences

3. Organization of submitted article

The organization of the submitted article consists of Title, Abstract, Index Terms, Introduction, Method, Result and Discussion, Conclusion, Appendix (if any), Acknowledgment (if any), and References.

- Title
  The maximum words count on the title is 12 words (including the subtitle if available)
- Abstract
  Abstract consists of 150-250 words. The abstract should contain logical argumentation of the research taken, problem-solving methodology, research results, and a brief conclusion.
- Index terms
  A list in alphabetical order in between 4 to 6 words or short phrases separated by a semicolon (;), excluding words used in the title and chosen carefully to reflect the precise content of the paper.
- Introduction
  Introduction commonly contains the background, purpose of the research, problem identification, research methodology, and state of the art conducted by the authors which describe implicitly.
- Method
  Include sufficient details for the work to be repeated. Where specific equipment and materials are named, the manufacturer's details (name, city and country) should be given so that readers can trace specifications by contacting the manufacturer. Where commercially available software has been used, details of the supplier should be given in brackets or the reference given in full in the reference list.
- Results and Discussion
  State the results of experimental or modeling work, drawing attention to important details in tables and figures, and discuss them intensively by comparing and/or citing other references.
- Conclusion
  Explicitly describes the research's results been taken. Future works or suggestion could be explained after it
- Appendix and acknowledgment, if available, could be placed after Conclusion.
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Every submitted paper is independently and blindly reviewed by at least two peer-reviewers. The decision for publication, amendment, or rejection is based upon their reports/recommendations. If two or more reviewers consider a manuscript unsuitable for publication in this journal, a statement explaining the basis for the decision will be sent to the authors within six months of the submission date.

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- **Periodicals**
  J.K. Author, "Name of paper," Abbrev. Title of Periodical, vol. x, no. x, pp. xxx-xxx, Sept. 2013.

- **Book**
  J.K. Author, "Title of chapter in the book," in Title of His Published Book, xth ed. City of Publisher, Country or Nation: Abbrev. Of Publisher, year, ch. x, sec. x, pp xxx-xxx.

- **Report**
  J.K. Author, "Title of report," Abbrev. Name of Co., City of Co., Abbrev. State, Rep. xxx, year.

- **Handbook**
  Name of Manual/ Handbook, x ed., Abbrev. Name of Co., City of Co., Abbrev. State, year, pp. xxx-xxx.

- **Published Conference Proceedings**
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  J.K. Author, "Title of paper," unpublished. J.K. Author, "Title of paper," Abbrev. Title of Journal, in press.

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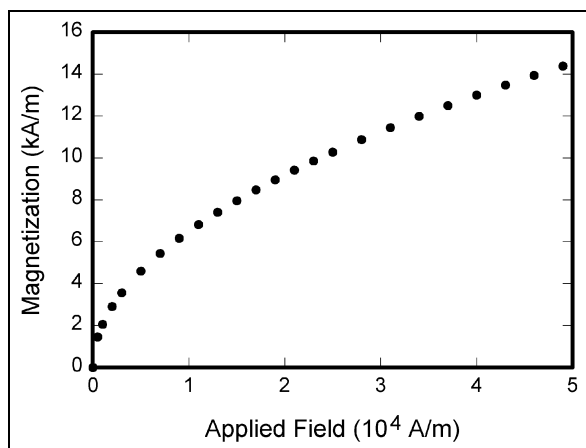| Table Head	Table Column Head		
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Fig. 1. Example of a figure caption

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APPENDIX

Appendixes, if needed, appear before the acknowledgment.

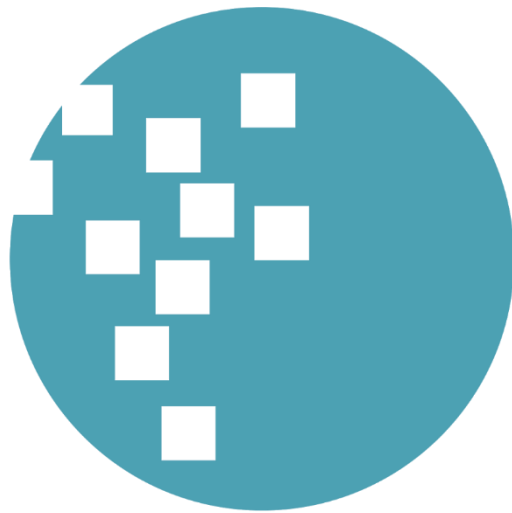## ACKNOWLEDGMENT

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[1]   G. Eason, B. Noble, and I.N. Sneddon, "On certain integrals of Lipschitz-Hankel type involving products of Bessel functions," Phil. Trans. Roy. Soc. London, vol. A247, pp. 529-551, April 1955. (references)

[2]   J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68-73.

[3]   I.S. Jacobs and C.P. Bean, "Fine particles, thin films and exchange anisotropy," in Magnetism, vol. III, G.T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271-350.

[4]   K. Elissa, "Title of paper if known," unpublished.

[5]   R. Nicole, "Title of paper with only first word capitalized," J. Name Stand. Abbrev., in press.

[6]   Y. Yorozu, M. Hirano, K. Oka, and Y. Tagawa, "Electron spectroscopy studies on magneto-optical media and plastic substrate interface," IEEE Transl. J. Magn. Japan, vol. 2, pp. 740-741, August 1987 [Digests 9th Annual Conf. Magnetics Japan, p. 301, 1982].

[7]   M. Young, The Technical Writer's Handbook. Mill Valley, CA: University Science, 1989.