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Jurnal of Technology Informatics (JoTI) merupakan media penyampaian hasil penelitian untuk semua bidang keilmuan Teknik Informatika dan Teknik Elektro yang terbit dua kali dalamsetahun yaitu April dan Oktober, dengan E-ISSN 2686-6102 dan P-ISSN 2721-4842, yang diterbitkan oleh Universitas Dinamika pertama kali tahun 2019.

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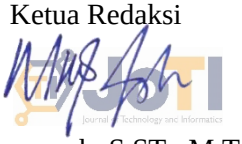
Kata Pengantar

Puji Syukur kehadirat Tuhan Yang Maha Esa atas berkat dan karunia-Nya makalah ilmiah *Jurnal of Techology Informatics* dapat terbit sebagaimana yang telah direncanakan.

Sebagai Tenaga Profesional Dosen, memiliki kewajiban mengajar, meneliti, dan melakukan pengabdian masyarakat. Setiap hasil penelitian sebaiknya dipublikasikan untuk membagi apa yang telah diteliti dan memberitahu kepada masyarakat luas mengenai hasil penelitian. JoTI diharapkan, menjadi wadah dan sarana untuk penyebaran ilmu pengetahuan dan hasil penelitian di bidang Teknik Informatika dan Teknik Elektro secara berkelanjutan. JoTI juga diharapkan menjadi wadah pertemuan para penelitian dan dunia industri yang tertarik pada hasil penelitian. Terbitan JoTI dilakukan dua kali (April dan Oktober) dalam satu tahun melalui proses *review* yang berpengalaman dan sudah memiliki makalah yang diterbitkan di jurnal Internasional.

Kami mengucapkan terimakasih kepada peneliti yang telah mengirimkan hasil penelitiannya lewat JoTI, kepada Mitra Bestari yang sudah meluangkan waktu guna me-*review* malakah yang kami ajukan, serta kepada Universitas Dinamika yang mendukung penuh atas pengelolaan jurnal ini, dan kami mengucapkan terimakasih kepada semua pihak, baik yang terlibat secara langsung ataupun tidak langsung.

Ketua Redaksi



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Design and Implementation of a Responsive Web-based System for Controlling the Financial Budget of Universities

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Abstract: *The management of the financial budget of universities is an extremely complex task due to having numerous different documents and calculation processes. In many developing regions and countries including the Kurdistan Region of Iraq, budget execution and accounting processes are manual. This had deleterious effects on the functioning of their expenditure and income management. This research represents the design and implementation of a responsive web-based system for controlling the financial budget of universities. This system can improve the recording and processing of financial transactions. Moreover, it traces all the stages of the transaction processing from budget releases, does auditing, and accounting of expenditures, incomes, deposits, and funds. Furthermore, it provides financial information on present and past performance. The system is a responsive web-based system, which adjusts the layout of the pages based on the screen size and orientation of the user's device. The system was implemented by using programming languages such as HTML, PHP, JavaScript, jQuery, AJAX, and MySQL. Finally, the provided system needed to be investigated from the performance point of view. Therefore, a questionnaire was used to determine the system's usability by using the System Usability Scale (SUS) tool. The results revealed that a score of 86.250% of satisfaction has been achieved.*

Keywords*: Financial Budget; RWD; SUS; SWOT*

INTRODUCTION

For more than one reason, organizations regardless of their forms and purposes, use accounting records. In enterprises, account information is used for decision-making, but it can also be used according to an organization's needs and specifications [1]. Primarily, the accounting data required by the organization was manually prepared by the accountant, which has a variety of problems and negatives. Fortunately, technical advances have culminated in the implementation of computerized accounting systems that have helped accountants solve their accounting problems and enhance their jobs [2]. These systems have been used globally in industry and have carried competitive advantages and profits with them. Organizations should strengthen and expand their processes in such a manner that quality knowledge can be generated and used for improved decision-making [3].

The style of system design, however often depends on the organization's volume, the number of transaction details, the scope of tasks, the organizational structure, and the business form [4]. Via many meetings and interviews with budget accountants at universities, it has been observed that all of them continue to use paper and manual instruments to maintain their records. To keep up with the new automated methods of handling financial budget operations found in modern organizations, this equipment is too old. It has also been noted that this system has some negative effects and has created numerous issues, such as: Firstly, it is time-consuming in terms of time, as it takes a long time to pass the information to the relevant units. Second, paper records are non-value-added operations in terms of value-added operations since they are hard to retrieve, modify, and re-file.

There has been a significant amount of research conducted on financial budget systems using various methodologies. One such study, conducted by Song [5], developed a system design specifically for colleges and universities, titled "College Financial Management System Research and Design," with the aim of simplifying financial management tasks and improving efficiency in the institutions under study. The design incorporated modules for user management, account management, employee information management, and student fee management to improve the interpretation of financial management information systems. Findings indicated that the proposed system had the potential to improve decision-making, transaction processing, internal control, report quality, and performance measures. However, the author acknowledged that further investigation was required to address existing deficiencies and improve the design.

Zhijun [6], conducted an analysis and developed a system for managing the budgets of scientific research projects at universities. The study revealed several issues with managing scientific research project funds, particularly in budget management. The system implemented several functions such as source management, budget management, expenditure management, and inquiry statistics. The system development tool utilized was Visual Studio, while the background data management system was SQL Server. The designer emphasized the system's practicality and

effectiveness in achieving dynamic management and budget planning for scientific research projects at universities.

Capucao et al [7]. developed a web-based budget management system for state universities and colleges. The existing budget process cycle was analyzed, and flaws were identified. The proposed system was developed using the model, view, and controller framework and the rapid application development methodology. Faculty, staff, and students evaluated the system and gave excellent ratings for functionality, usability, and efficiency. The system met the requirements and was strongly recommended for adoption. The development of this system addresses the gap in online budget management and can improve organizational performance.

In another study, Kurniawan et al. [8] presented a web-based financial information system, which was developed for independent educational accreditation institution in Indonesia using the Waterfall method with Laravel and MySQL. The system has two main features, which are budgeting the operations and financial management for accreditation. Its budgeting feature helps prepare financial plans for the future, while the management accounting feature provides information and analysis for problem-solving. The system promotes transparency, accountability, and good accounting practices. The study found that the system was effective in managing finances and accreditation activities in higher education.

Our proposed system is distinct from prior works as it can be applied in universities with one-unit or multi-unit budget accounting. Furthermore, it automates all auditing processes, and its flexible design allows new units, users, transaction types, and categories can easily be added without modifying the code. In addition, the system utilizes a responsive web design technique to dynamically adjust the web page layout based on the user's screen size and orientation.

This study aims to enhance the management of university budgets by proposing a system that facilitates administrative tasks, improves real-time financial data accessibility for management units, facilitates departmental collaboration, and streamlines the sharing of resources, skills, and information among financial units. Successful implementation of the proposed system is expected to enhance universities' budget management practices, enabling them to achieve greater efficiency and effectiveness.

RESEARCH METHOD

More than one style has been used to gather and obtain the requirement of the system development, these styles are:

Data Collection

The first step in developing any system is known to be data collection and analysis. Thus, to be able to develop a system, the research begins by gathering data and requirements from various environments. Therefore, more than one procedure or instrument has been used at one time to effectively execute this process:

Quantitative Method

The SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis has been used in this study as a quantitative method to analyze both the external and internal factors of the project challenges and relying on the surrounding environments weaknesses and strengths [9]. Both a questionnaire and an interview were conducted with university staff to identify the opportunities and threats associated with information technology services on campus, leading to direct and reliable access to information from beneficiaries. A questionnaire was designed based on SWOT factors, which were modified by experts in the field of strategic planning. By using this approach, the study was able to gather comprehensive data and develop a detailed analysis of the internal and external environment of the universities.

Qualitative Method

SUS is being used to evaluate the implementation of the system with the contribution of potential users, who are working on the manual financial budget for the university, and they are intending to use the system after the completion of the testing stage. The system usability test covers users' interface (UI) presentation and also, it contains other important features such as learning, satisfaction, error rate, the persistence of users over time, and performance.

Observation

Observations have also been made inside the university campus and affected the outcomes and discussion of findings, from which some of the needed data has been collected.

SYSTEM REQUIREMENTS

For developing an effective web system, a range of software and hardware tools is required. These requirements include editors for programming languages, Cascading Style Sheet (CSS), Hypertext Markup Language (HTML), Personal Home Page (PHP), MySQL database, Bootstrap Framework, JavaScript including (jQuery, Ajax, and JSON), web and database server, and a web browser.

SYSTEM DESIGN

This section shows how the system is designed and structured. It contains diagrams to explain the modules that define the system. Moreover, includes the GUI design which describes the graphic interface of the system.

System Modules

The main factors and specifications of the system have been categorized into modules. These modules have been selected based on the system requirements, observations, and interviews with the potential users. The system modules are classified into six categories, as shown in Figure 1.

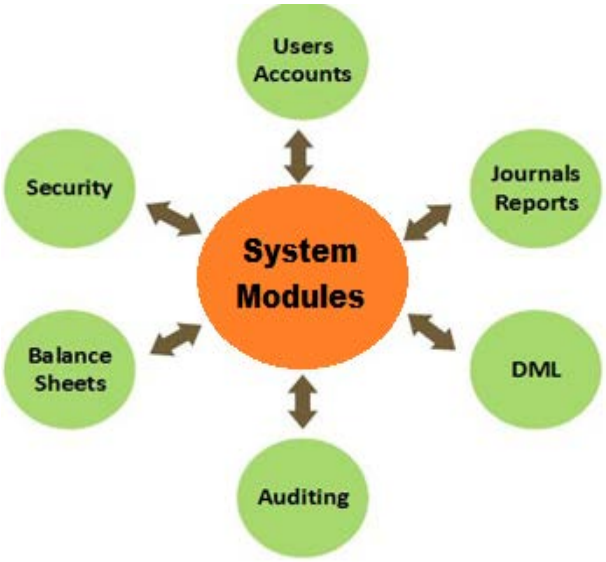

Figure 1. System Modules

Users' Accounts Module

This system is considered a dynamic system due to having the capability of inserting, updating, and removing each faculty with its accounts. Each faculty has many accounts for its users and each account has a distinct role from other accounts. The roles in the proposed system are divided into six categories: main admin, faculty admin, fund accountant, main accountant, auditor, and authorized viewer. Every user is responsible for a variety of tasks. Whereas the tasks of the users depend on their role. Also, each faculty account can have access only to the budget that belongs to his/her faculty. Each user has a profile, which contains information such as the user's name, email, faculty, role, etc. The various types of roles and their tasks and permissions in the system are as follows:

1) Main admin: The use case diagram is used to visualize the main admin's role such as the tasks and permissions that have as shown in Figure 2.

   The main admin is the exclusive user who has the authority for adding, editing, and removing an account, giving roles, handling permissions and accessing the settings. In addition, the main admin will have access to the faculty's budget, which belongs to his faculty, as well as to the aggregate budget of all faculties, aggregate reports, and balance sheets. Moreover, initial data can be inserted, edited, and removed only by the main admin such as categories, types, and faculties. Furthermore, the To-Do list of each user can only be added by the main admin.
2) Faculty Admin: every user with a faculty admin role can perform the roles of all other users of their faculty except the main admin role. such as DML operations on Journals data, auditing, viewing the dashboard, and also viewing, printing, and exporting Journals reports and balance sheets. Furthermore, they have the authority to change their personal information such as a password, email, and phone number.
3) Main accountant: The main accountants do not have authorization for data insertion to only the Fund Journal. while having permission to make DML operations on all other Journals, viewing the dashboard, and also viewing, printing, and exporting Journals reports and balance sheets. Moreover, the main accountants have the authority to change their personal information.
4) Auditor: The auditors have the permission to audit, edit personal information, viewing the dashboard, and also viewing, printing, and exporting Journals reports and balance sheets. Whereas they do not have the authorization to correct an error if exists.
5) Fund accountant: is only allowed to fund accountants to add, edit and delete data from Fund Journal. Furthermore, the fund accountants can edit their personal information, viewing the dashboard, and also viewing, printing, and exporting Journals reports and balance sheets.
6) Authorized viewer: The authorized viewers have the authority for viewing, printing, and exporting Journals reports and balance sheets as well as viewing the dashboard. Furthermore, they have the authority to change their personal information like phone number, email, picture, and password.

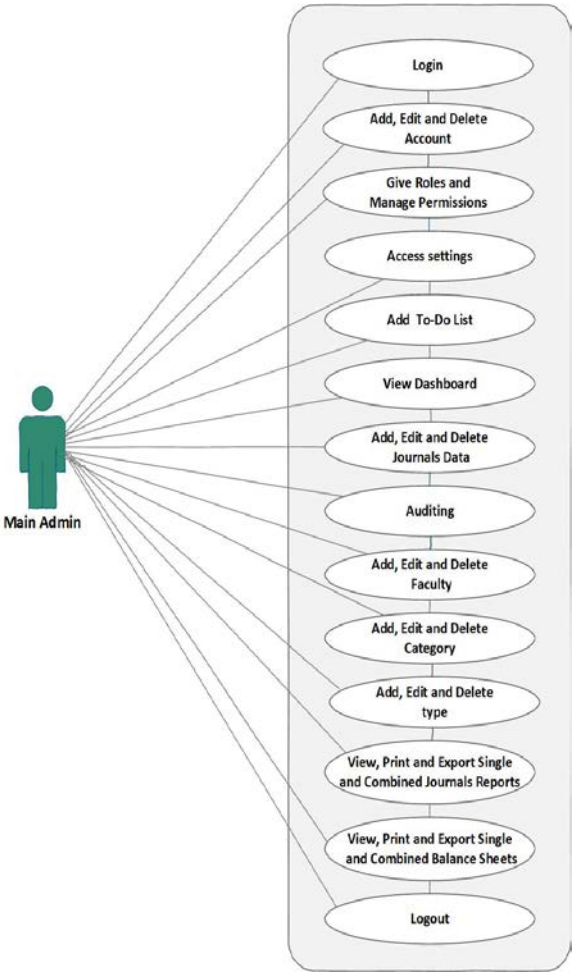

Figure 2. The Use Case Diagram of The Main Admin

Journals Reports Module

One of the most critical aspects of the system is the creation of reports from the Journals. There are five Journals in the system namely General, Deposit, Fund, Expense, and Income, and each of these Journals has a report. The production of all reports is automatic. Also, the system interacts with three different types of Bonds, these bonds are Expense, Receipt, and Transfer. Each bond's data must be inserted to the General Journal first because the General Journal is considered the main Journal in the system, while the insertion of data to the other Journals depends on the contents of the Bonds, for instance, Expense Bond's data can be inserted to both General and Expense Journals or in addition to the previous Journals, can be added to the third Journal such as Deposit Journal. The Journal contains two accounts for Transactions which are credit and debit, as well as Statistical data, for any Transaction, credits and debits totals must be equal and always in balance. When there is no balance in a Transaction, it will not be possible to establish financial statements. Reports display the Transactions that have been added to Journals according to the month that has been chosen as shown in Figure 3, Furthermore, all reports have the functionality of printing and exporting to Excel sheets.

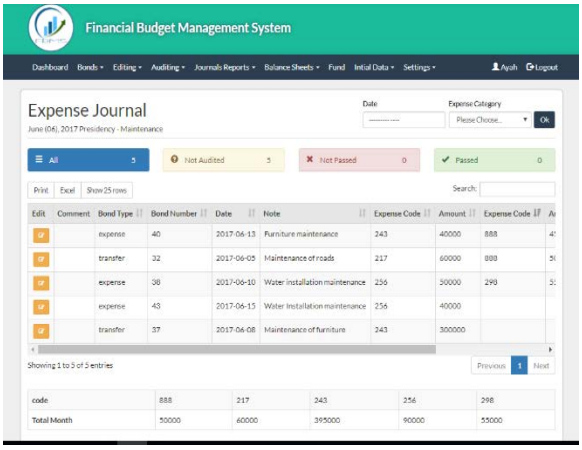

Figure 3. The Report of The Expense Journal

Data Manipulation Language (DML) Module

The DML operations include insert, update, and deleting, these operations are implemented in the system on all Journals, initial data, and user's personal information. After each DML operation, a notification message will appear to inform the user of the success of the operation or the failure of the operation if an error happened during the operation execution.

i. DML operations on Journals: Each Transaction's debit and credit amounts can be inserted, modified, and deleted as well as DML operations can be performed on the data of all Journals. There is the risk of having errors and the occurrence of interruption during the insertion period since the system contains several Journals and the insertion to all these Journals is carried out on a single page. MySQL Transactions were used in the system to prevent such errors as it makes all manipulation operations a group of sequential operations. The Transactions will be completed when all operations of the sequential group are successfully executed. The whole Transaction will fail in case the failure occurs in any operation within the Transaction. In case the Transaction is successfully completed, the "COMMIT" command will be issued to apply modifications to all the tables referenced in that specific Transaction. If a failure happens, a 'ROLLBACK' command will be issued to restore the prior state of each table referenced in the transaction.

ii. DML on initial data: The system is capable of inserting, modifying, and deleting users, categories, types, and faculties.

iii. DML on users' personal information: DML operations can be performed by the users on some of their personal information such as password, phone number, and email.

Auditing Module

The audit is quite important to ensure that the Journals and balance sheets are correct and without mistakes. The identification and prevention of errors are highly necessary to ensure the efficiency and quality of the records. The auditor has permission to audit the data, but not to alter it. After the insertions of Journals, the auditing process begins by the auditor. The auditing page is shown in Figure 4, which consists of the statistical part and the records auditing part. The statistical part gives statistics about the number of records in the page, the number of records not been audited, the number of records that contain errors, and the number of records without errors. The records auditing part contains the records and each record have three checkboxes; if the record is without mistakes the "✓" checkbox will be clicked, if an error exists the "✗" checkbox will be clicked, while the "N/A" checkbox is automatically checked when the record is not audit yet.

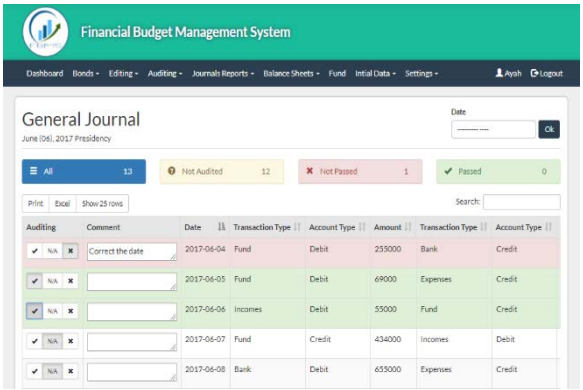

Figure 4. The Auditing Page of General Journal

In case an error exists, the accountants will fix it, so the balance sheets can be generated. The process of auditing is shown in Figure 5.

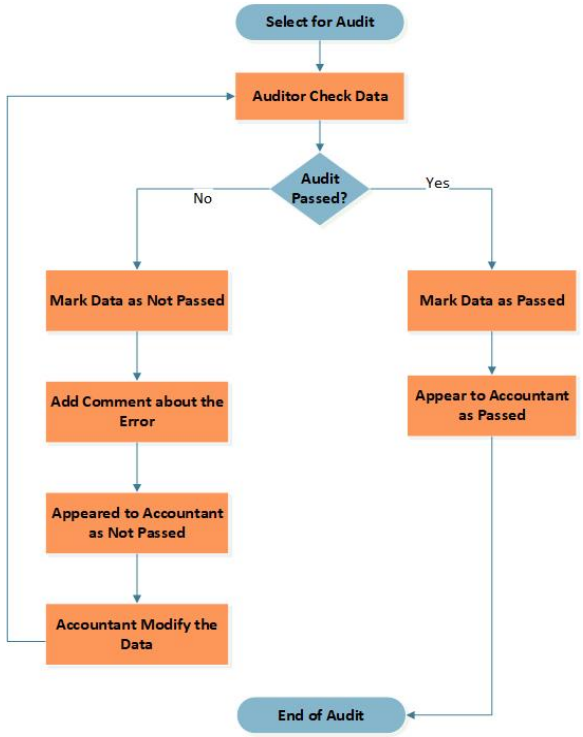

Figure 5. The Auditing Flowchart

Balance Sheets Module

Balance sheets are financial documents that identify the amount of money circulating in each Transaction on a specific date. Also, Balance sheets contain summarized information about Transactions as well as includes debit and credit accounts which are automatically generated. To attain a final value, all Transactions need to be calculated. It is possible to merge the balance sheets of all faculties. Besides, these sheets are printable and can be converted to an Excel file. After the auditing process is completed, the balance sheets will be generated, which consists of seven types, such as Transactions, Expense categories, Expense types, Deposits, Incomes, Imprest, and Fund balance sheet.

The general balance sheet in the system is the Transaction balance sheet that contains the total of debit and credit accounts of all Transactions in the system. A variety of different calculations exist for each sheet. The steps of the calculation processes of balance sheets are shown in Figure 6.

Security Module

The security of the data in this system has been taken into consideration by applying many security features to the system such as data protection and data encryption. The encryption of the users' passwords is a crucial security step that must be taken in creating any new system that requires users' passwords [10]. If an attack happened to the systems' database, the data of the system including passwords can be easily stolen if they are not encrypted, due to that, in this system, sensitive data are encrypted using Bcrypt encryption. Bcrypt encryption is an algorithm for hashing passwords that are based on the Blowfish cipher algorithm [11]. This algorithm prevents passwords from being stored in plain text. Rather it hashes the passwords and only saves the hashed one, this avoids the attacker from directly accessing the real passwords.

In terms of security and privacy, each faculty has its budget independently from other faculties and each one of these faculties has several accounts for its users, each of these accounts can only access the budget of the faculty that belongs to. Also, every user's account has permission to only access the information related to the account's role. Moreover, the system prevents the use of the "Get" method for protection purposes, which transfers the data via URL and exposes the URL data.

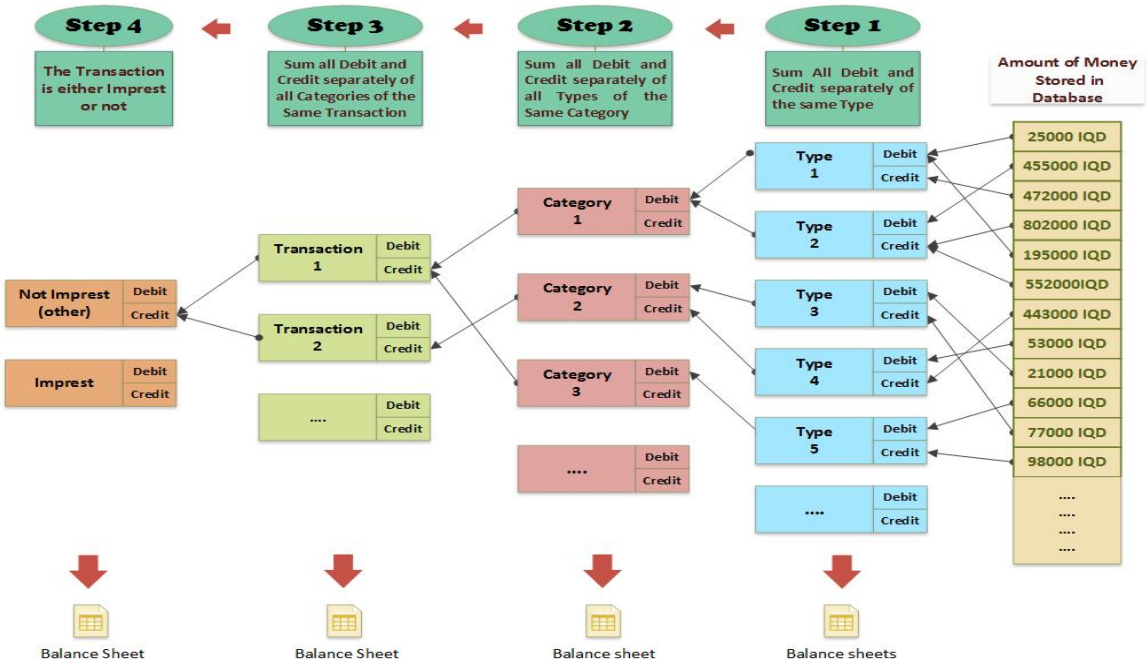

Figure 6. The Balance Sheets Calculation Process

Graphical User Interface (GUI) Design

The graphical user interface GUI of the system is both user-friendly and easy to use. For all types of users' accounts, the GUI consists of two separate sections, dashboard and menu bar, as shown in Figure 7. The dashboard is a very effective way to monitor data from multiple sources because it provides real-time data and combines important information in one single location for the users. All the users based on their roles have different menu bars contents from each other.

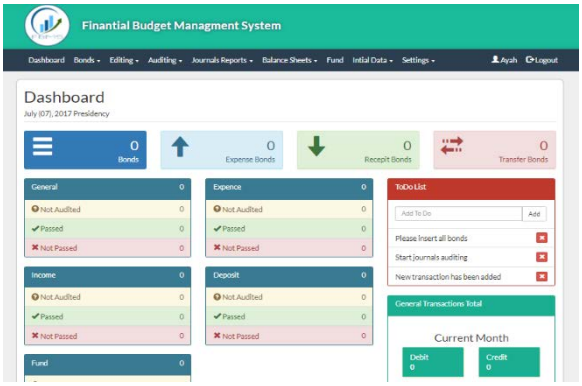

Figure 7. GUI Design

In terms of web pages design, this system has followed the Responsive Web Design (RWD) technique, this technique by its role adjusts the layout of the pages based on the screen size and orientation of the user's device [12], due to this the system becomes more user friendly and easily readable, as seen in Figure 8.

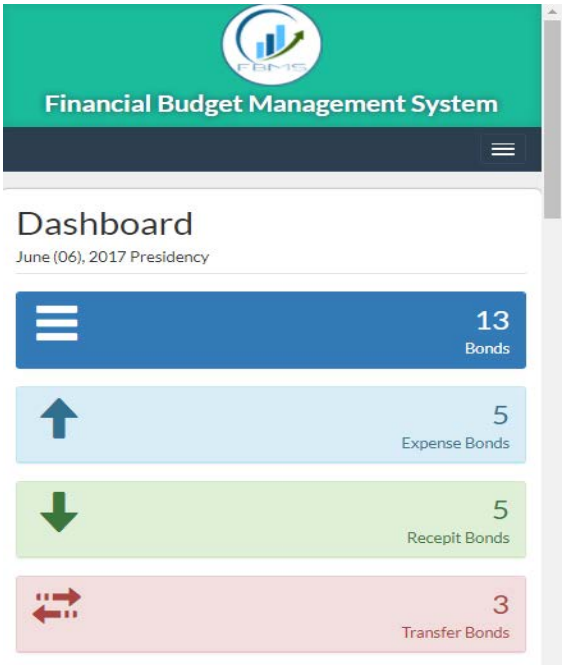

Figure 8. Responsive Web Design

SYSTEM USABILITY TESTING

It Is critical to determine what is the usability test means here? It means tracking a user's actions while dealing with the system and evaluating the usability of the system [13].

The usability test covers users' interface presentation and tells users how to communicate with the system. Also, it contains other important features such as learning, satisfaction, error rate, the persistence of users over time, and performance [14]. The general usability process for developing a system with the degree of usability needed will be presented here. This process is implemented with a small variance by most usability practitioners, is based around a concept evaluate-redesign loop. By analyzing the intended users and the activities that users conduct, practitioners start the procedure.

SUS was designed to objectively assess the system's performance, efficacy, and satisfaction as a quantitative tool. The SUS consists of ten items, favorably formulating the odd-numbered items and negatively formulating the even-numbered items [15]. The system is tested by the contribution of (24) potential users, the results of the system testing were analyzed as in Table 1 and Table 2.

Table 1. SUS Score by The Participants

Participant	SUS Score	Participant	SUS Score
1	87%	13	72.5%
2	82.5%	14	95%
3	75%	15	92.5%
4	87.5%	16	90%
5	82.5%	17	95%
6	95%	18	92.5%
7	72.5%	19	100%
8	100%	20	85%
9	95%	21	87.5%
10	72.5%	22	100%
11	95%	23	100%
12	100%	24	100%
SUS Total Score		86.250%	

Table 2. SUS Questionnaires

#	Questions	Strongly Disagree	Strongly Agree
1	I would like to make frequent use of the system		24
2	I have found the system unnecessarily complicated	22	2
3	The system was simple to use		24
4	To be able to use the system, I will require assistance	19	5
5	The different functions are quite well integrated		24
6	There's so much inconsistency in the system	21	3
7	Many individuals will know to use this system very rapidly		24
8	This system is very cumbersome and requires to be used with considerable effort	22	2
9	I felt very comfortable using this system	3	21
10	Before I could get going with this system, I needed to learn many things	18	6

The smallest SUS score is (72.5), whereas the highest score is (100), as seen in Table I. The overall SUS score is thus (86.250%), meaning that the system is generally accepted as a (70%) acceptable ratio in compliance with the rules of the SUS tool. Depending on

the user's degree of acceptance, each of the above 10 template questions has been graded from (1 to 5). The score was calculated according to the following:

- Subtract 1 out of the score for every odd-numbered question.
- Subtract their value from 5 for every even-numbered question.
- Take the new values and add the overall score, then multiply it by 2.5.

According to the potential users involved in the sus assessment, the system is user-friendly and easy to use and provides a complementary connection between the management of financial units, which makes the financial budget processes much easier and faster. The result of the SUS showed that the system satisfies all the user's requirements with (86.250%) total satisfaction.

CONCLUSION

The findings of the study have shown that there is an urgent need for an electronic financial budget system in all understudy universities. The system is built to protect and promote users' privacy by allowing users to view only pages and data belonging to their functions and units. Moreover, the sensitive data are encrypted to enhance data protection so the attackers cannot access sensitive data directly. The budget of all units in some understudy universities has been created in the university presidency, whereas in other universities, all units produce their budget independently, after that the university presidency unifies the budget of all these units into a united one. The proposed system is built to be very flexible, which accepts both cases and has the functionality of adding new units. Furthermore, it generates the balance sheets and reports automatically and without mistakes due to the electronic auditing process and making all the required calculation processes automatically. The result of the SUS assessment showed that the total satisfaction was (86.250%), which means that the system is user-friendly and easy to use and satisfies all the user's requirements.

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Sistem Informasi Penggajian *Rider* di *Mini Station* Ninja Xpress Sidoarjo

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Abstrak: Produk sistem informasi sangat dibutuhkan di era perkembangan teknologi pada masa sekarang. Adanya suatu sistem informasi dapat menggantikan suatu sistem perhitungan *manual* yang telah diterapkan sejak bertahun-tahun lamanya, salah satu contohnya yaitu Sistem Informasi Penggajian. Sistem informasi yang berkaitan dengan ilmu akuntansi gaji dan upah tersebut telah diadaptasi oleh beberapa perusahaan besar di Indonesia, tetapi pada PT. Andiarta Muzizat (Ninja Xpress) yang bergerak di jasa pengiriman paket belum sepenuhnya mengadaptasi atau menerapkan Sistem Informasi Penggajian khususnya untuk *rider* (kurir). Maka dari itu dibutuhkan suatu Sistem Informasi Penggajian yang dapat menghitung secara cepat dan rinci perihal penggajian para *rider* (kurir) di setiap bulannya. Penerapan Sistem Informasi Penggajian kali ini diterapkan di salah satu cabang dari Ninja Xpress yaitu *Mini Station* Ninja Xpress Sidoarjo. Dengan menggunakan metode *Extreme Programming* (XP) yang menerapkan proses pendekatan pengembangan sistem informasi dengan tahapan *planning* (perencanaan), *design* (perancangan), *coding* (*testing*), dan *testing* (pengujian). Hasil akhir dari penelitian ini berupa suatu Sistem Informasi Penggajian yang dapat menghitung secara detail pendapatan setiap *rider* (kurir) mulai dari gaji kotor, bonus *rider*, dan gaji bersih yang diterima oleh *rider* (kurir) di setiap bulannya dalam format *web* dengan menggunakan bahasa pemrograman PHP dan MySQL.

Kata Kunci: *Extreme Programming;* Penggajian; Sistem Informasi

Abstract: *Information system products are needed in the current era of technological development. The existence of an information system can replace a manual calculation system that has been implemented for many years, one example is the Payroll Information System. The information system related to salary and wage accounting has been adopted by several large companies in Indonesia but at PT. Andiarta Muzizat (Ninja Xpress), which operates package delivery services, has not fully adopted or implemented a Payroll Information System, especially for riders (couriers). Therefore, we need a Payroll Information System that can calculate quickly and in detail the payroll of the riders (courier) every month. The implementation of Payroll Information System this time was implemented in one of the branches of Ninja Xpress, namely Mini Station Ninja Xpress Sidoarjo. By using the Extreme Programming (XP) method, which applies the process approach to developing information systems with the stages of planning, design, coding, and testing. The result of this research is a Payroll Information System that can calculate in detail the income of each rider (courier) starting from the gross salary, rider bonus, and net salary received by the rider (courier) every month in a web format using the PHP programming language and MySQL.*

Keywords: *System Information; Payroll; Extreme Programming*

PENDAHULUAN

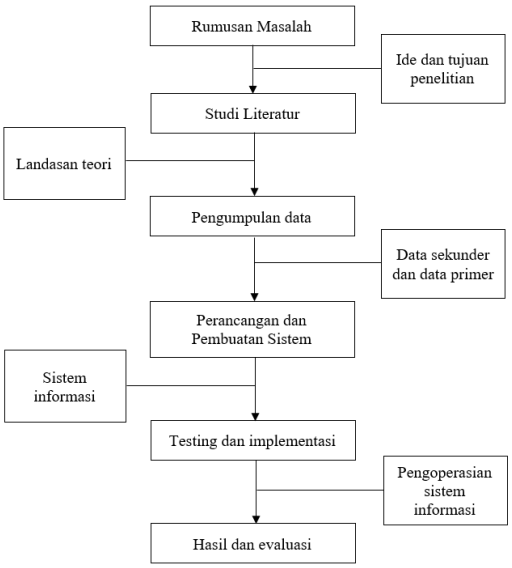
Sejalan dengan perkembangan teknologi di Indonesia yang sangat pesat, saat ini sudah seharusnya sebuah perusahaan membutuhkan sebuah sistem informasi penggajian yang dapat mengoptimalkan kinerja perusahaan. Sistem informasi penggajian adalah sebuah solusi untuk mempermudah staf atau karyawan untuk mendapatkan informasi terkait data gaji karyawan di perusahaan tersebut. Salah satu bidang usaha yang sedang berkembang tersebut yaitu, bidang usaha jasa pengiriman atau penerimaan barang atau logistik lainnya yang berbasis teknologi yaitu, Ninja Xpress yang di naungi PT. Andiarta Muzizat. Di era globalisasi, banyak persaingan untuk memimpin bisnis di perusahaan. Semua persaingan membutuhkan sistem informasi yang *valid* untuk digunakan oleh manajemen untuk mengambil keputusan yang tepat yang akan memutuskan hak dan meningkatkan kinerja perusahaan dan menjadi pemimpin dari semua perusahaan yang berada dalam jenis bisnis yang sama [4]. Dalam Jurnal yang ditulis oleh Rahmawati, dkk [5], dijelasakan bahwa gaji adalah balas jasa berupa uang yang diterima oleh seorang pegawai sebagai akibat dari jabatannya sebagai karyawan yang telah memberikan kontribusi dan juga pemikirannya untuk mencapai suatu tujuan bagi perusahaan. Temuan tersebut mengungkapkan bahwa penerapan sistem penggajian dan informasi personel terintegrasi telah berfungsi sebagai alat yang benar-benar dalam mengabadikan akuntabilitas [6].

Didalam penelitian ini yang menjadi bahasan yaitu *rider* SPH dari *mini station* Ninja Xpress Sidoarjo. SPH merupakan singkatan dari Si Penghubung Harapan, yang artinya kurir Ninja Xpress diharapkan berperan sebagai penghubung harapan dari para pelanggan. Di program SPH ini ada banyak komponen perhitungan gaji yang masuk dalam sistem informasi penggajian. Namun sistem informasi penggajian yang ada tersebut dirasa belum maksimal, dikarenakan sering terjadi selisih

seperti perhitungan kinerja khususnya pada gaji *rider*. Di *Mini station* Ninja Xpress Sidoarjo sering didapati komplain terkait gaji oleh *rider*, hal tersebut dikarenakan dari sisi *rider* sendiri seringkali memiliki perhitungan kinerjanya secara rinci. Seringkali terjadi perselisihan penerimaan gaji yang dikarenakan, *rider* merasa bahwa gaji tersebut kurang atau tidak sesuai dengan rincian kinerja yang telah diperhitungkan oleh *rider* tersebut. Berdasarkan latar belakang tersebut maka dilakukanlah penelitian terkait Sistem Informasi penggajian *rider* di *mini station* Ninja Xpress Sidoarjo". Maka dari itu diharapkan dengan dilakukannya penelitian ini dapat meminimalisir terjadinya perselisihan antara gaji tersebut dan dapat menjadi alternatif penyelesaian dari permasalahan tersebut.

METODE PENELITIAN

Dalam penelitian ini ada tahapan-tahapan aktivitas yang akan dilakukan, tahapan-tahapan tersebut merupakan cara untuk mencapai tujuan dalam penelitian. Berikut Gambar 1, merupakan gambaran kerangka kerja penelitian yang akan dilakukan:



Gambar 1. Kerangka Kerja Penelitian

Penelitian ini diawali dengan studi lapangan terlebih dahulu di *mini station* Ninja Xpress Sidoarjo setelah itu diperoleh sebuah ide penelitian untuk membahas terkait penggajian. Dari ide yang muncul tersebut maka dapatkan rumusan masalah yaitu, bagaimana menjadikan sistem informasi penggajian *rider* menjadi alternatif dari penyelesaian masalah penggajian dan inventarisasi data untuk arsip di *mini station* Ninja Xpress Sidoarjo.

Setelah didapatkan rumusan masalah tersebut dilanjutkan dengan melakukan studi literatur terhadap sumber-sumber seperti jurnal, buku, skripsi dan penelitian terdahulu sebagai dasar acuan dalam melakukan penelitian.

Setelah tahap tersebut mulai dilakukan pengumpulan data yang berupa data sekunder secara langsung dari pihak *mini station* Ninja Xpress Sidoarjo. Tahap pengumpulan data ini dilakukan guna memperoleh informasi yang dibutuhkan oleh penulis untuk mencapai tujuan penelitian dalam membuat sebuah sistem informasi. Setelah diperoleh data yang cukup, maka dilanjutkan ke tahap selanjutnya yaitu, tahap pembuatan sistem informasi penggajian.

Sistem informasi yang akan digunakan pada penelitian ini menggunakan sistem informasi berbasis *web*. Langkah selanjutnya setelah sistem informasi dibuat maka dilanjutkan ke tahap *testing* dan implementasi pada sistem informasi. Hal tersebut dilakukan guna mengetahui apakah sistem informasi tersebut dapat berjalan sesuai perencanaan penelitian ataukah tidak. Langkah terakhir setelah tahap *testing* dan implementasi dilanjutkan dengan melakukan evaluasi terhadap hasil yang didapat tersebut.

Merumuskan penggajian pengembang dalam proyek pengembangan perangkat lunak penting bagi organisasi untuk memberikan gaji yang adil formulasi yang dapat memotivasi pengembang untuk bekerja secara profesional. Penggajian juga dapat dijadikan acuan dalam merencanakan biaya proyek pengembangan perangkat lunak untuk memenuhi kesuksesan finansial *startup*. Dalam literatur, estimasi penggajian pengembang dapat diperoleh dengan mengalikan jumlah jam kerja suatu proyek dengan upah pengembang. Namun, mengalikan angkanya. Jam kerja dengan upah pengembang dianggap tidak adil karena masing-masing pengembang memiliki kompetensi dan pertunjukan [7].

Maka dari itu dengan dibuatnya penelitian ini, diharapkan sistem penggajian *rider* yang terdapat pada *mini station* Ninja Xpress Sidoarjo dapat lebih terstruktur lagi dengan *output* berupa perhitungan gaji *rider* di setiap bulannya. Sistem ini nantinya diimplementasikan dengan menggunakan bahasa pemrograman PHP dengan bantuan *My*SQL.

HASIL DAN PEMBAHASAN

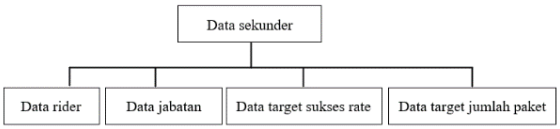
Pada penelitian kali ini terdapat beberapa tahapan hasil dan pembahasan, diantaranya yaitu:

Tahap Perencanaan

Setelah dari tahapan metodologi penelitian dilanjutkan ke tahap perencaan. Dimana pada tahap ini dilakukan penentuan langkah-langkah yang akan dilakukan pada penelitian ini. Adapun langkah-langkah tersebut sebagai berikut:

1. Pengumpulan Data

Sebelum melakukan perancangan aplikasi langkah-langkah yang dilakukan yaitu, menyiapkan data sekunder yang diperoleh di *Mini station* Ninja Xpress Sidoarjo. Tahapan awal yang dilakukan yaitu, mengumpulkan data sekunder yang diperoleh pada saat studi lapangan, adapun data tersebut digambarkan pada bagan yang ditunjukkan pada Gambar 2.



Gambar 2. Bagan Data Sekunder

2. Kategori Data

Adapun kategori data yang digunakan pada penelitian ini adalah sebagai berikut:

a. Data *Rider*

Data *rider* yang digunakan pada penelitian ini yaitu 5 *sample* data *rider* dengan jabatan yang berbeda, data tersebut ditunjukkan pada Tabel 1.

Tabel 1. Data Nama *Rider*

No.	*Rider*	Jabatan
1.	*Rider* A	Berlian
2.	*Rider* B	Platinum
3.	*Rider* C	Emas
4.	*Rider* D	Perak
5.	*Rider* E	Perunggu

b. Data Jabatan

Data jabatan yang ditunjukkan pada Tabel 2. merupakan penggolongan *rider* berdasarkan performa kinerja. Minimum hari kerja di tabel dibawah ini adalah acuan *rider* untuk naik ke tahap selanjutnya yang dapat diambil contoh jika *rider* A berada di jabatan perak, maka *rider* tersebut wajib minimum masuk 10 hari kerja untuk naik jabatan emas.

Tabel 2. Data Jabatan

No.	Jabatan	*Minimum* Hari Masuk
1.	Berlian	25
2.	Platinum	25
3.	Emas	20
4.	Perak	10
5.	Perunggu	0

c. Data Target Sukses *Rate*

Pada data yang ada pada Tabel 3. *Mini station* Ninja Xpress Sidoarjo Masuk di kategori JA1. Sesuai dengan kategori JA1 maka jika *rider* ingin mempertahankan atau mencapai ke jenjang jabatan selanjutnya maka *rider* wajib memenuhi target sesuai Tabel 3. Jika *rider* di jabatan perak maka *rider* harus bisa mempertahankan sukses *rate* di angka 88%.

Tabel 3. Target Sukses *Rate*

Success Rate (3 Bulan)	Perak	Emas	Platinum	Berlian
AA1	88,0%	90,0%	92,0%	94,0%
AB1	88,0%	90,0%	92,0%	94,0%
JA1	88,0%	90,0%	92,0%	94,0%
JA2	88,0%	90,0%	92,0%	94,0%
JA3	88,0%	90,0%	92,0%	94,0%
JB1	88,0%	90,0%	92,0%	94,0%
JB2	88,0%	90,0%	92,0%	94,0%
JB3	88,0%	90,0%	92,0%	94,0%
JC1	88,0%	90,0%	92,0%	94,0%
JC2	88,0%	90,0%	92,0%	94,0%
JC3	88,0%	90,0%	92,0%	94,0%

d. Data Target Jumlah Paket

Sesuai dengan kategori JA1 maka jika *rider* ingin mempertahankan atau mencapai ke jenjang jabatan selanjutnya maka *rider* wajib memenuhi target sesuai Tabel 4. Jika *rider* di jabatan perak maka *rider* harus bisa mempertahankan target paket sukses minimal 1250 paket sukses.

Tabel 4. Target Paket Sukses

Success Rate (3 Bulan)	Perak	Emas	Platinum	Berlian
AA1	1,650	3,375	6,000	9,000
AB1	1,650	3,375	6,000	9,000
JA1	1,250	2,300	4,250	7,550
JA2	1,200	2,250	4,200	7,500
JA3	1,200	2,250	4,200	7,500
JB1	1,080	2,025	3,900	7,125
JB2	1,080	2,025	3,900	7,125
JB3	1,080	2,025	3,900	7,125
JC1	9,60	1,800	3,600	6,750
JC2	9,60	1,800	3,600	6,750
JC3	9,60	1,800	3,600	6,750

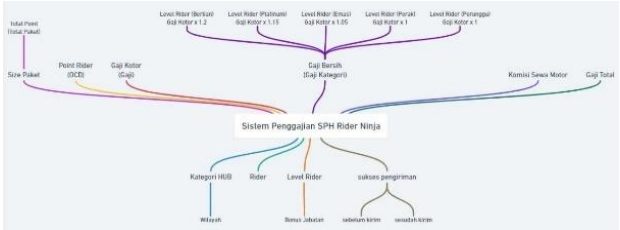
Tahap Perancangan

Pada tahapan ini dilakukan perancangan sistem informasi dengan menggunakan data yang di peroleh dari tahap sebelumnya. Adapun langkah-langkahnya adalah sebagai berikut:

1. Perancangan Dasar

a. *Mind Map*

Mind mapping merupakan cara untuk menempatkan informasi ke dalam otak dan mengimplementasikannya kembali dalam bentuk nyata. Bentuk *mind mapping* seperti peta sebuah jalan yang mempunyai banyak cabang, yang dimana peta *rute* yang digunakan ingatan, membuat kita bisa menyusun fakta dan fikiran sedemikian rupa sehingga cara kerja otak kita yang alami akan dilibatkan sejak awal sehingga mengingat informasi akan lebih mudah dan bisa diandalkan daripada menggunakan teknik mencatat biasa [8]. Berikut pada Gambar 3. adalah gambar *mind map* dari tahapan penelitian ini:



Gambar 3. *Mind Map* SPH *Rider Mini Station* Ninja Xpress Sidoarjo

Mind map yang ditunjukkan pada Gambar 3. pada penelitian ini dirancang guna menentukan lingkungan aplikasi dalam pengembangan aplikasi yang dimulai dari kategori *hub*, dimana didalamnya terdapat suatu wilayah *coverage* untuk menentukan cakupan dari pada *rider* bekerja nantinya, lalu ada *rider* dimana *rider* tersebut juga memiliki identitas berupa *rider id*, lalu jabatan *rider* yang memungkinkan *rider* akan naik jabatan dimana dalam skema tersebut juga memiliki suatu bonus tergantung dari jabatan yang diraih.

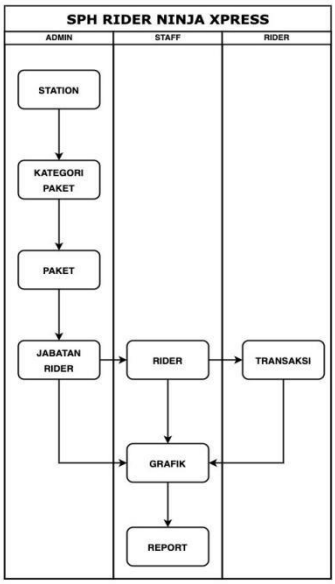
Setelah itu dibagian atas *mind map* ada proses transaksi, yang dimulai dari *size* paket dimana ada beberapa *size* pada penelitian ini yaitu S (*small*), M (*medium*), L (*large*) dan XL (*Extra large*). Untuk ukuran S-M bernilai 1 poin dan untuk ukuran L-XL bernilai 2,5 poin. Sehingga setelah *rider* menyelesaikan pengiriman, akan terjadi akumulasi dari total paket yang dibawa oleh *rider* tersebut berupa total poin. Selanjutnya jika jumlah poin sudah ditentukan maka akan ada perhitungan gaji kotor dengan persamaan (1).

$$GK = (tp \times 500) + \% \times UMK \ldots\ldots\ldots\ldots (1)$$

Keterangan:
GK : Gaji Kotor
tp : total point

b. *Flowchart*

Bagan alir atau *flowchart* adalah bagan (*chart*) yang menunjukkan aliran (*flow*) di dalam program atau prosedur sistem secara logika, digunakan terutama sebagai alat bantu komunkasi dan untuk dokumentasi [9]. *Flowchart* dari program yang akan dirancang ditunjukkan pada Gambar 5.

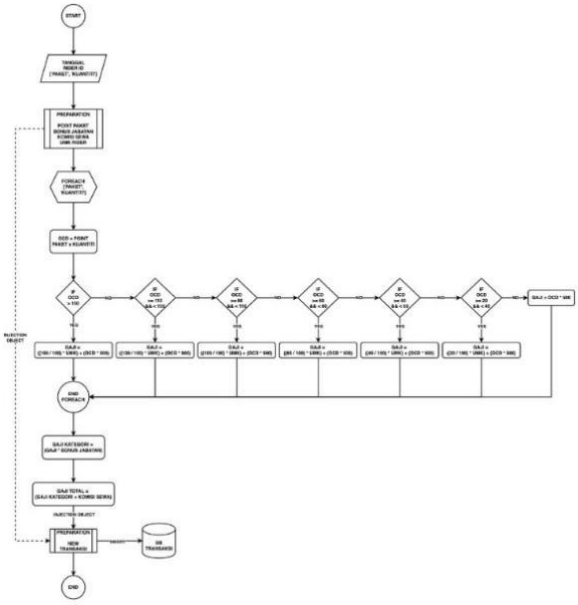


Gambar 5. *Flowchart Modular*

Pada Gambar 5. menjelaskan *flowchart* secara keseluruhan pada proses penelitian ini. Admin pada penelitian ini dapat melakukan seluruh akses yang meliputi penambahan kategori paket, paket, jabatan *rider*, *rider*, melakukan transaksi, melihat grafik dan mengunduh *report*.

Sedangkan untuk staf hanya terbatas untuk mengakses penambahan *rider* dan melakukan transaksi guna mengisi pendapatan *rider* setiap harinya. Pada bagian *rider* hanya dapat melihat grafik dan total paket yang dibawa.

Gambar 6. menunjukan *flowchart* transaksi dimana terdapat transaksi atau perhitungan gaji *rider* untuk setiap harinya. Diawali dengan mengisi tanggal transaksi, setelah itu pilih *rider* dan mengisi kuantiti. Kuantiti pada *flowchart* diatas ada 2 yaitu kuantiti untuk kategori paket *small* dan *bulky*. Yang memiliki nilai konstan perhitungan kategori *small* memperoleh 1 poin dan *bulky* 2,5 poin. Ketika kuantiti telah terisi, kemudian diakumulasikan menjadi poin. Setelah poin dihitung maka akan ada perhitungan gaji kotor berdasarkan poin yang diperoleh.



Gambar 6. *Flowchart* Transaksi

Rumus untuk perhitungan gaji kotor ditunjukkan pada Tabel 5.

Tabel 5. Rumus Perhitungan Gaji Kotor

No.	Poin	Perhitungan
1.	>150	(150%*UMK) + (poin*500)
2.	>=110 dan <150	(130%*UMK) + (poin*500)
3.	>=80 dan <110	(100%*UMK) + (poin*500)
4.	>=60 dan <80	(65%*UMK) + (poin*500)
5.	>=40 dan <60	(45%*UMK) + (poin*500)
6.	>=20 dan <40	(30%*UMK) + (poin*500)
7.	<20	poin*500

Setelah di temukan gaji kotor akan ada perhitungan gaji bersih yaitu sesuai jabatan *rider* yang telah ditunjukkan pada Tabel 6.

Tabel 6. Rumus Perhitungan Gaji Bersih

No.	Jabatan	Perhitungan
1.	Berlian	gaji kotor*1,2 dan bonus jabatan 500.000
2.	Platinum	gaji kotor*1,15 dan bonus jabatan 300.000
3.	Emas	gaji kotor*1,05 dan bonus jabatan 100.000
4.	Perak	gaji kotor*1 dan tidak mendapatkan bonus jabatan
5.	Perunggu	gaji kotor*1 dan tidak mendapatkan bonus jabatan

Catatan: untuk bonus jabatan sendiri berskala periodik bulanan.

Setelah gaji bersih ditentukan, maka dilakukan dengan perhitungan gaji total yang dapat diketahui dengan perhitungan gaji bersih ditambah dengan uang sewa motor per harinya. Adapun uang sewa motor sendiri hanya diberikan kepada level berlian, platinum dan emas.

c. *Entity Realitionship Diagram* (ERD)

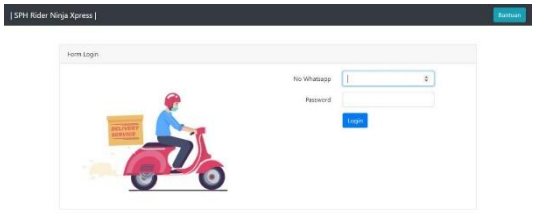
Setelah membuat *Mind Mapping* dilanjutkan dengan pembuatan *Entity Realitionship Diagram* (ERD) yang ditunjukkan pada Gambar 7. Metode di mana langkah-langkah proses ini diselesaikan dalam kerangka kerja dijelaskan secara rinci dan ditunjukkan bagaimana mengembangkan diagram hubungan entitas dari informasi yang diperoleh dari pengguna [10].

Gambar 7. *Entity Relationship Diagram* (ERD)

2. Perancangan *Interface*

Pada tahapan perancangan ini dilakukan percancangan tampilan *interface* pada sistem informasi yang dibuat pada penelitian ini, sebagai berikut:

a. Login

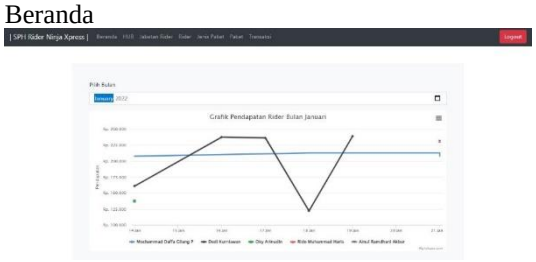


Gambar 8. *Form Login*

Pada Gambar 8. merupakan tampilan utama sistem informasi pada penelitian ini yaitu *form login*. Pada *form login* tersebut user melakukan input berupa nomor WhatsApp dan *password*. *User* disini terbagi menjadi 3 user dengan yaitu, admin, staf dan *rider* dengan hak akses yang berbeda-beda.

Untuk *login* disini pengguna menggunakan nomor WhatsApp dan *password* sebagai inputan untuk masuk halaman *website*. Pada bagian *login* sendiri terbagi menjadi 3 bagian yaitu, admin, staf, dan *rider* dengan hak akses yang berbeda-beda.

b. Beranda



Gambar 9. Tampilan Beranda

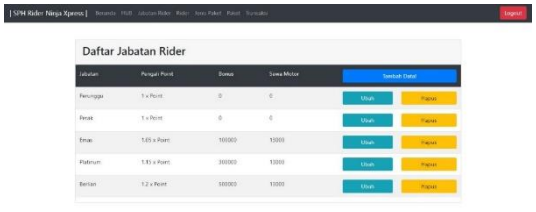
Gambar 9. adalah tampilan beranda yang dimana terdapat tampilan grafik pendapatan bulanan *rider* yang dapat di lihat berdasarkan bulan yang diinginkan atau dipilih.

c. Master Data HUB

Gambar 10. Master Data HUB

Gambar 10. merupakan tampilan master data HUB. Fungsi HUB disini berguna untuk menentukan gudang, *mini station*, kabupaten atau kota, kecamatan, dan UMK. Untuk akses master data HUB hanya bisa diakses admin saja.

d. Master Data Jabatan *Rider*



Gambar 11. Master Data Jabatan *Rider*

Pada Gambar 11. menjelaskan terkait master jabatan *rider* yang berisi jabatan, pengali poin, bonus bulanan, dan uang sewa motor. Pada tahun ini skema jabatan di Ninja Xpress sendiri hanya ada 5 jabatan, yang dimulai dari level teratas yaitu, berlian, platinum, emas, perak, dan perunggu. Jabatan disini mempengaruhi gaji *rider*, dengan jabatan yang berbeda *rider* akan mendapatkan pengali poin yang berbeda. Bonus disini adalah bonus bulanan, pendapatan bonus bulanan berdasarkan jabatan *rider* tersebut.

e. Master Data *Rider* atau Pengguna

Gambar 12. Master Data *Rider* atau Pengguna

Gambar 12. berupa tampilan master data *rider* atau pengguna. Pada master data ini terdapat tampilan berupa hub, nama, jabatan *rider* beserta nomor WhatsApp yang digunakan untuk *login*. Kemudian terdapat tombol seperti master data yang lainnya yaitu, tombol tambah data, ubah, hapus dan disini terdapat tambahan satu tombol *reset password* pengguna.

f. Master Data Jenis Paket

Gambar 13. Master Data Jenis Paket

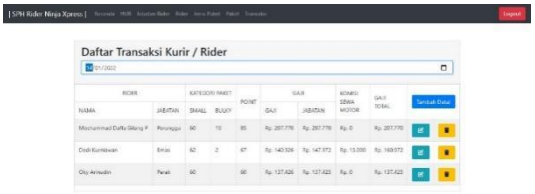
Pada Gambar 13. menunjukkan tampilan master data jenis paket, fungsi jenis paket disini yaitu untuk perhitungan poin. Pada penelitian ini terdapat 2 jenis paket yaitu, *small* bernilai 1 poin dan *bulky* 2,5 poin.

g. Master Data Paket

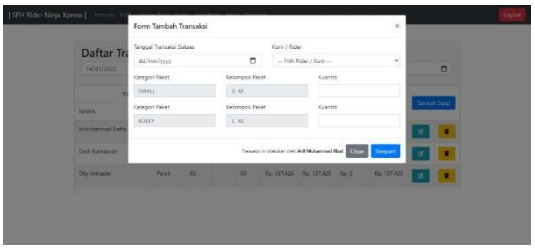
Gambar 14. Master Data Paket

Pada Gambar 14. menjelaskan Master data paket yang berisi paket berdasarkan nama dan jenis paket. Pada penelitian ini terdapat 4 nama paket dengan 2 poin yang sama dan 2 jenis yang sama. Dimana ukuran S-M masuk jenis paket *small* dengan perolehan 1 poin dan ukuran L-XL masuk jenis *bulky* dengan perolehan 2,5 poin.

h. Master Data Transaksi

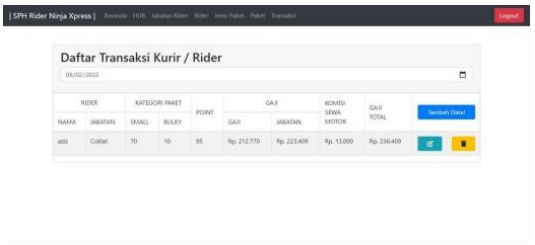


Gambar 15. Master Data Transaksi



Gambar 16. *Form* Tambah, Ubah, Simpan Transaksi

Pada master data transaksi yang ditunjukkan pada Gambar 15. berisi nama *rider*, jabatan, kategori paket, poin, gaji, gaji berdasarkan jabatan, komisi sewa motor dan gaji total. Ketika akan melihat transaksi, harus memasukkan tanggal yang ditentukan. Akses untuk master data ini hanya dapat dilakukan oleh admin dan staf. Gambar 16. menunjukkan halaman *form* tambah, ubah, simpan transaksi adalah *form* untuk menambahkan transaksi yang akan dilakukan.



Gambar 17. Hasil Perhitungan

Adapun penjelasan pada Gambar 17, pada data transaksi tanggal 06 Februari 2022, rider atas nama aziz dengan jabatan *rider* coklat membawa paket *small* 70 paket dan *bulky* 10 paket. Sehingga point yang di dapat oleh Aziz 70 + (2,5 x 10) = 95 *Point*. Sehingga gaji yang di peroleh Rp. 212.770. Untuk gaji tersebut belum termasuk gaji jabatan. Aziz adalah *rider* coklat, sehingga gaji yang di peroleh aziz akan di rumuskan sebagai berikut: (Gaji x 1,05) + uang sewa motor (13.000) = Rp. 236.409.

KESIMPULAN DAN SARAN

Berdasarkan hasil penelitian yang dilakukan, Sistem informasi yang telah dibuat sudah dapat mengatasi permasalahan terkait penggajian dan inventarisi data di *Mini station* Ninja Xpress Sidoarjo. Hal tersebut dapat dibuktikan dimana sistem informasi yang dibuat telah mampu mengakomodir skema penggajian *rider Mini station* Ninja Xpress Sidoarjo secara rinci, yang dapat digunakan untuk menyanggah

apabila terjadi selisih atau ketidaksesuaian gaji yang diperoleh oleh *rider*.

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Rancang Bangun Aplikasi Penjualan *Online* Pada UMKM Riot Safe Menggunakan *Gamification*

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Abstrak: Riot Safe merupakan salah satu UMKM yang bergerak di bidang penjualan pakaian polos seperti kaos, *hoodies*, *long sleeves* dan *sweeteners*. Riot Safe menyediakan pembelian *online* dan *offline* yang dilakukan melalui media sosial seperti *Instagram* dan *WhatsApp*. Banyaknya *direct message* yang masuk secara bersamaan membuat pengelola kesulitan mencatat setiap transaksi. Hal tersebut mengakibatkan pengelola kesulitan membuat laporan penjualan. Selain itu pengelola kesulitan mengelola persediaan barang yang mengakibatkan pelanggan sulit mendapatkan barang khususnya saat *stock* terbatas. Penelitian ini merupakan penelitian terapan yang berdasarkan masalah tersebut, penelitian ini mengembangkan aplikasi penjualan *online* dengan menerapkan metode *Gamification*. Metode *Gamification* yang digunakan menerapkan empat elemen yaitu *points*, *leaderboards*, *badges*, dan *prizes* yang dapat digunakan sebagai daya tarik bagi pelanggan. Hasil penelitian berupa aplikasi penjualan *online* yang diterapkan untuk membantu pengelola mencatat transaksi, dan menghasilkan laporan yang dibutuhkan. Aplikasi juga memiliki fitur *Gamification* yang dapat memicu pelanggan untuk aktif berbelanja dengan mengumpulkan poin. Hasil pengujian aplikasi kepada pengguna yaitu 5 orang pengelola Riot Safe dan 25 pelanggan menunjukkan bahwa 100% pengelola menyatakan bahwa aplikasi sudah sesuai untuk mengelola transaksi secara *online*, 97% pelanggan akan menggunakan aplikasi dengan sistem poin, dan 93% pelanggan akan terus berbelanja menggunakan aplikasi karena mendapatkan potongan harga.

Kata Kunci: *Gamification; Online; Points*

Abstract: *Riot Safe is one of the SMEs selling plain clothes such as t-shirts, hoodies, long sleeves, and sweatshirts. Riot Safe provides online and offline purchases through social media platforms on Instagram and WhatsApp. The high number of direct messages received simultaneously makes it difficult for the manager to record each transaction. These have resulted in difficulty in creating sales reports. In addition, the manager struggles to manage the inventory, which makes it difficult for customers to obtain items, especially when stock is limited. This study is applied research based on the problem. The research developed an online sales application by applying Gamification methods. The Gamification method used four elements, namely points, leaderboards, badges, and prizes, which as attractions for customers. The research resulted in an online sales application helping the manager to record transactions and create reports. The application also has Gamification features that trigger customers to actively shop by collecting points. The results of testing the application on users, namely 5 Riot Safe managers and 25 customers, show that 100% of managers stated that the application was suitable for managing online transactions, 97% of customers would use an application with a point system, and 93% of customers would continue to shop using the application because get a discount.*

Keywords*: Gamification; Online; Points*

PENDAHULUAN

Riot Safe merupakan salah satu Usaha Mikro Kecil dan Menengah (UMKM) yang bergerak dalam bidang penjualan pakaian polos seperti kaos, *hoodie, long sleve*, dan *sweeter*. Berdasarkan hasil wawancara dengan pemilik UMKM Riot Safe dalam pelayanannya, sebelum pandemi toko didominasi oleh pelanggan yang datang langsung ke toko (*offline*) dengan rata-rata penjualan sebanyak 10 (sepuluh) barang terjual per hari. Pada saat pandemi penjualan dengan rata-rata sebanyak 6 (enam) terjual per hari. Penjualan merupakan pengalihan atau pemindahan hak kepemilikan atas barang atau jasa [1]. Oleh sebab itu UMKM Riot Safe berjualan secara *online*, melalui media sosial seperti *Instagram* dan *WhatsApp*.

Dalam penjualan secara *online*, Riot Safe memiliki satu admin yang bertugas untuk melayani penjualan secara *online* yaitu dengan menanggapi *direct message* yang masuk, memberikan *form order* kepada calon pelanggan, mengecek ketersediaan barang, mencatat transaksi penjualan yang dilakukan menggunakan *Instagram* dan *WhatsApp*, serta membuat laporan. Pelanggan merupakan seseorang yang datang atau memiliki kebiasaan untuk membeli sesuatu dari penjual [2]. Permasalahannya adalah banyaknya *direct message* yang masuk secara bersamaan menyebabkan admin kesulitan untuk pencatatan setiap transaksi. Admin juga kesulitan dalam menentukan pelanggan yang mendapatkan barang (jika stok barang terbatas). Permasalahan lainnya admin merasa kesulitan dalam

pembuatan laporan penjualan, berdasarkan bukti pembayaran.

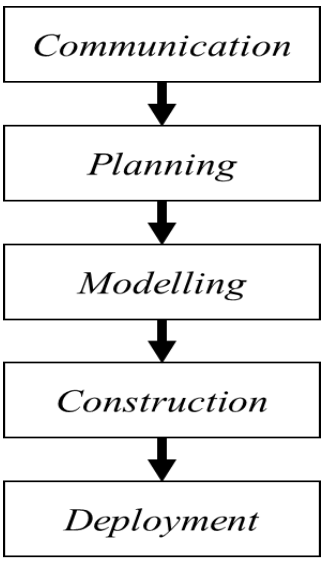
Solusi yang ditawarkan adalah pembuatan aplikasi penjualan secara *online* sehingga dapat memperluas jangkauan untuk calon pelanggan. Kemudian mempermudah pelanggan dalam transaksi dimanapun dan kapanpun tanpa perlu datang ke toko, mempermudah admin dalam mencatat setiap transaksi yang dilakukan, dan menyediakan *history* transaksi sehingga dapat dilakukan analisis bisnis untuk meningkatkan performa bisnis pada UMKM Riot Safe. Akan tetapi dalam proses membangun penjualan *online* harus memiliki daya tarik.

Oleh karena itu pada penelitian ini diterapkan metode *gamification.* Konsep *gamification* telah dibuktikan memberikan dampak signifikan terhadap peningkatan *engagement* [3] dan [4]. *Gamification* merupakan sebuah fitur yang terdapat pada suatu permainan yang dapat diimplementasikan ke dalam sebuah sistem untuk menguatkan motivasi dari pelanggan agar terus melakukan pembelian dan meningkatkan loyalitas pelanggan [3] dan [4]. Pada implementasi *gamification* terdapat empat elemen yaitu *points, leaderboard, badges,* dan *reward* [5]. Elemen *point* digunakan untuk menarik perhatian pelanggan supaya membeli produk. Dengan cara pelanggan membeli produk yang sudah ditawarkan maka poin akan didapatkan. Selain itu pelanggan bisa mendapatkan poin dengan menekan tombol konfirmasi barang yang sudah dibeli. Kemudian elemen *badges* digunakan untuk menentukan pendapatan total poin yang sudah didapatkan dari pelanggan [6]. *Badges* terdiri atas tiga level yaitu *bronze*, *silver*, dan *gold*. Pada setiap level memiliki kriteria yang berbeda beda. *Point* yang sudah dikumpulkan oleh pelanggan dapat ditukarkan berupa *reward* yang sudah ditentukan berdasarkan jumlah total poin yang didapatkan dari pelanggan, berupa potongan harga. Dengan adanya penerapan metode *gamification* pada penjualan *online* yang dibangun dapat meningkatkan penjualan produk pada UMKM Riot Safe. Riset lain yang menerapkan metode *game* antara lain: *Game* edukasi mitigasi bencana gempa bumi agar anak-anak lebih mudah mendapatkan informasi tentang gempa bumi [7], dan *Game* edukasi mitigasi bencana banjir berbasis *android* untuk menambah pengetahuan tentang mitigasi bencana banjir [8].

METODE

Penelitian ini terbagi menjadi 3 tahap yaitu tahap awal, tahap pengembangan, dan tahap akhir. Pada tahap awal dilakukan wawancara dan observasi terkait proses bisnis di Riot Safe. Selain itu dilakukan juga studi literatur tentang *gamification* dan UMKM. Pada tahap awal didapatkan tentang kendala pengembangan UMKM dan kebutuhan aplikasi.

Pada tahap pengembangan dilakukan pembuatan aplikasi berdasarkan kebutuhan UMKM. Metode pengembangan aplikasi mengunakan *System Development Life Cycle (SDLC)* yang tampak pada Gambar 1. Pada tahap akhir dilakukan uji coba aplikasi oleh pemilik dan pengguna untuk mengetahui kesesuaian aplikasi dengan kebutuhan.



Gambar 1. *System Development Life Cycle* (SDLC)

Communication

Dilakukan wawancara dengan pihak pemilik UMKM Riot Safe dan observasi dengan tujuan mengumpulkan informasi serta data pendukung dalam menyelesaikan masalah. Berdasarkan informasi yang diterima maka identifikasi masalah dapat dilihat pada Tabel 1.

Tabel 1. Identifikasi Masalah

Masalah	Alternatif Solusi
Pencatatan barang, laporan penjualan, dan belum adanya sistem pemasaran yang menarik untuk mendukung penjualan *online* serta melakukan proses pembelian di UMKM Riot Safe.	1. Merancang aplikasi berupa *website* untuk mempermudah pengguna dalam transaksi secara *online.* 2. Implementasi *gamification point, leaderboard, badges,* dan *reward* pada rancang bangun sistem penjualan di UMKM Riot Safe.

Planning

Pada tahap *planning* berupa tahap rencana untuk pengerjaan aplikasi, meliputi tugas-tugas teknis yang akan dilakukan, risiko yang mungkin terjadi, sumber yang dibutuhkan, hasil yang akan dibuat, dan jadwal pengerjaan [9].

Modeling

Tahap *modelling* terdiri atas identifikasi kebutuhan pengguna, kebutuhan fungsional, kebutuhan non fungsional, dan kebutuhan sistem.

Kebutuhan Pengguna

Pada tahap identifikasi kebutuhan pengguna digunakan untuk menggambarkan keterkaitan kebutuhan pengguna pada sistem yang dibangun[10]. Berikut kebutuhan pengguna dapat dilihat pada Tabel 2.

Tabel 2. Identifikasi Kebutuhan Pengguna

User	Kebutuhan Sistem
Pemilik	Pemilik UMKM Riot Safe bertugas merencanakan strategi bisnis, meninjau jalannya bisnis, dan mengecek laporan bulanan.
Admin	Admin bertugas mengelola penjualan barang, keuangan, stok barang, dan konten *gamification*.
Pelanggan	Pelanggan yang melakukan proses transaksi pemesanan barang, konfirmasi penerimaan barang dan *gamification*.

Kebutuhan Fungsional

Kebutuhan fungsional merupakan pernyataan layanan yang harus diberikan kepada sistem agar dapat melakukan keperilakuannya dalam bereaksi terhadap masukan tertentu dan pada situasi tertentu [11].

Kebutuhan *Non* Fungsional

Pada tahapan ini digunakan untuk menganalisis kebutuhan sistem yang dibuat[12]. Berikut ini merupakan hasil dari kebutuhan *non* fungsional.

a. Sistem Keamanan, untuk menjaga dan memastikan data di sistem terjaga dari hak akses yang tidak berwenang. Untuk *login* harus mengisikan *username* dan *password* agar bisa mengakses aplikasi.
b. Hak Akses, berfungsi agar tidak terjadi transaksi dua kali yang tidak sesuai dengan sistem. Perbedaan hak akses antara admin dan pembeli pada sistem dapat dilihat pada Tabel 3.

Tabel 3. Kebutuhan *Non* Fungsional

No	Fungsi	Hak Akses	
		Admin	Pelanggan
1	Pengelolaan data pelanggan	CRUD	*Read*
2	Pengelolaan data barang	CRUD	-
3	Pengelolaan pemesanan pelanggan	*Insert, Read, Update*	*Insert, Read, Update*
4	Pengelolaan laporan penjualan	*Read*	-
5	Pengelolaan *gamification*	CRUD	*Read*
6	*Update* status pengiriman	-	*Insert*

Kebutuhan Sistem

Pada tahap kebutuhan sistem ini, terdapat spesifikasi perangkat lunak dan perangkat keras yang dapat dilihat pada Tabel 4.

Tabel 4. Kebutuhan Sistem

Item	Kelompok	Spesifikasi
Server	Perangkat Lunak	1. *Hosting.* 2. *Cloud Server* berbasis *website*.
Komputer Admin	Perangkat Keras	1. Monitor atau layar komputer. 2. *Mouse* dan *Keyboard.* 3. Minimal *processor core I 3.* 4. Memori *Random Access Memory* (RAM) minimal sebesar 4 *Gigabyte* (Gb). 5. Minimal kapasitas penyimpanan *Harddisk* (HDD) sebesar 256 Gb.
	Perangkat Lunak	1. Sistem Operasi minimal *Windows* 7. 2. *Google Chrome* minimal versi 10.
Komputer Pengembang	Perangkat Keras	1. Monitor atau layar komputer. 2. *Mouse* dan *Keyboard.* 3. Minimal *processor core* I 3. 4. Memori *Random Access Memory* (RAM) minimal sebesar 6 *Gigabyte* (Gb). 5. Minimal kapasitas penyimpanan *Harddisk* (HDD) sebesar 500 Gb.
	Perangkat Lunak	1. Sistem operasi minimal *Windows 7* 64 bit. 2. Visual Studio Code 1.47 3. XAMPP.

Perancangan Sistem

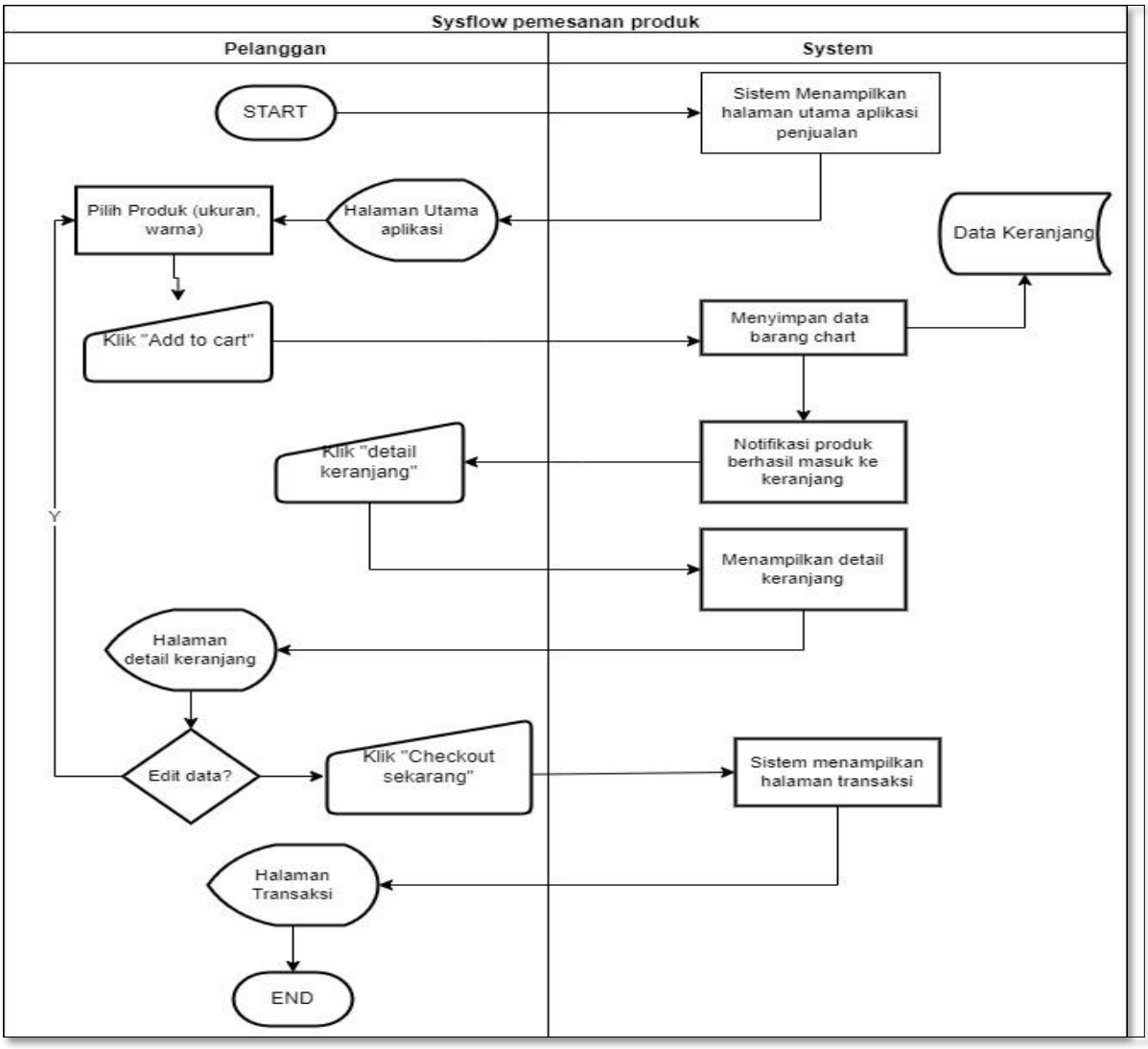
Alur sistem pemesanan secara umum tampak pada Gambar 2.

Context Diagram

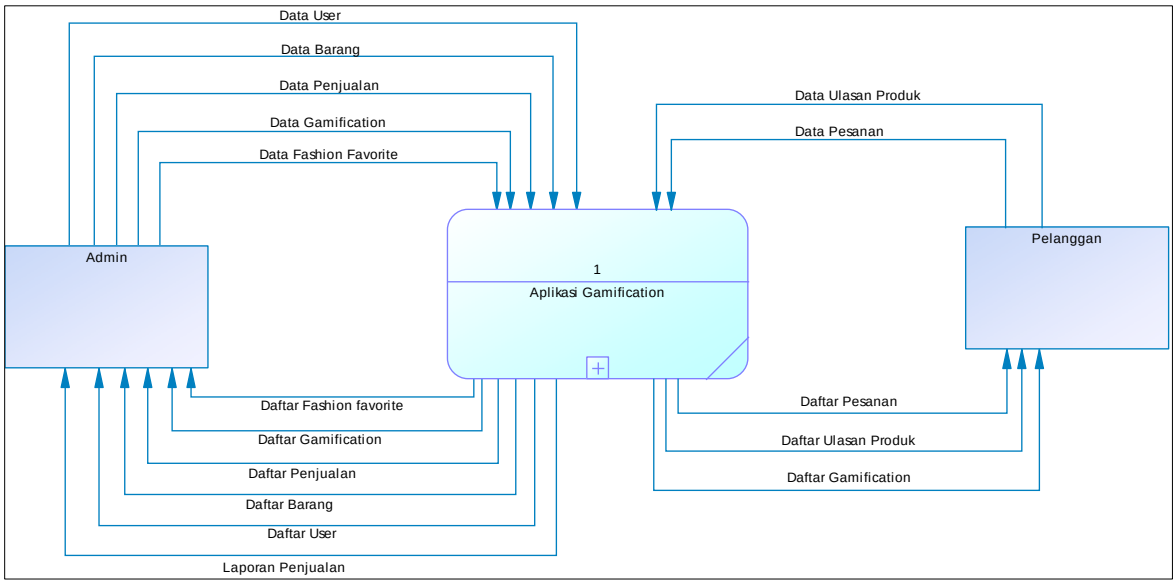
Context Diagram aplikasi yang dikembangkan dapat dilihat pada Gambar 3.

Data Flow Diagram

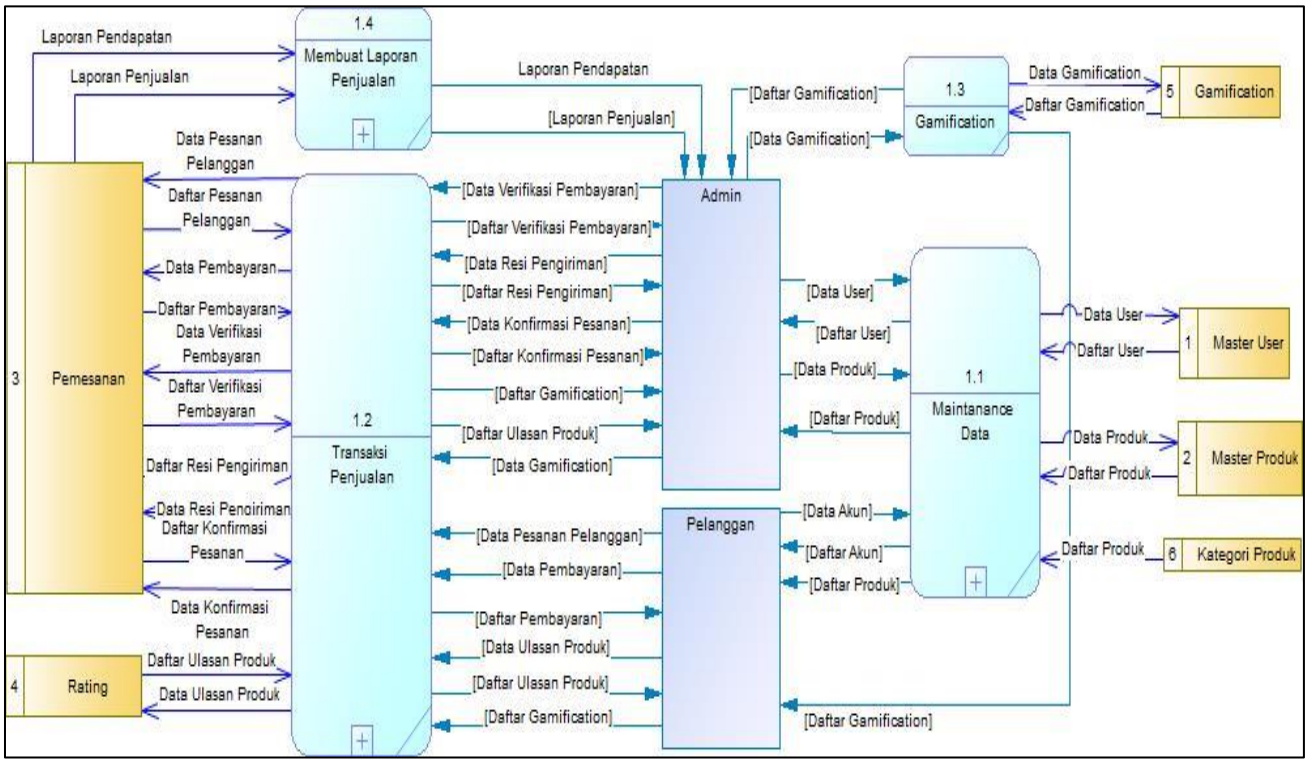
Data Flow Diagram menggambarkan aliran data sebuah sistem yang didapatkan dari masukan menjadi keluaran di setiap entitas. Terdapat proses dari setiap pembuatan aplikasi, antara lain *Data Flow Diagram Level* 0 dan *Data Flow Diagram Level* 1, yang dapat dilihat pada Gambar 4. dan Gambar 5.



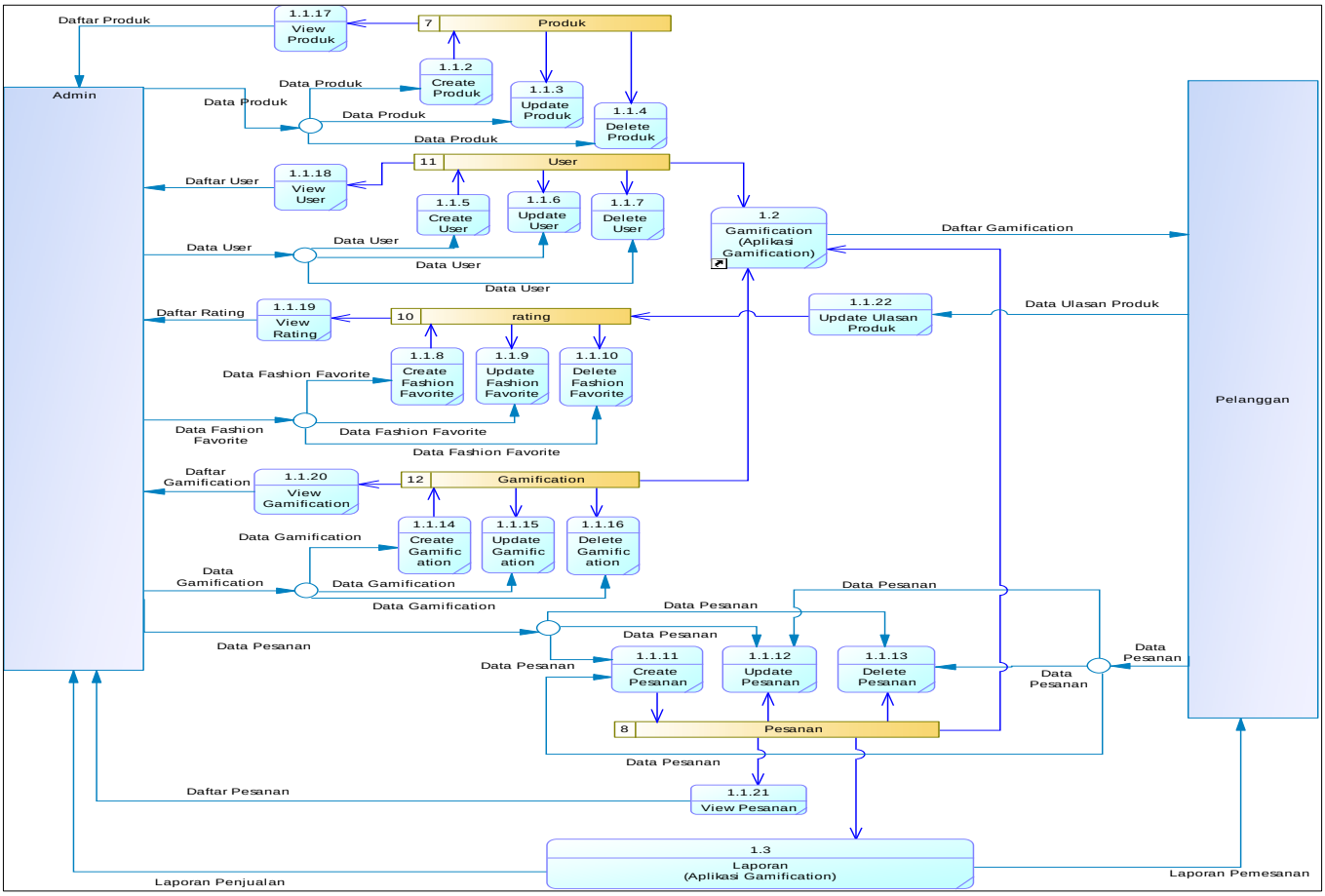
Gambar 2. *System Development Life Cycle*



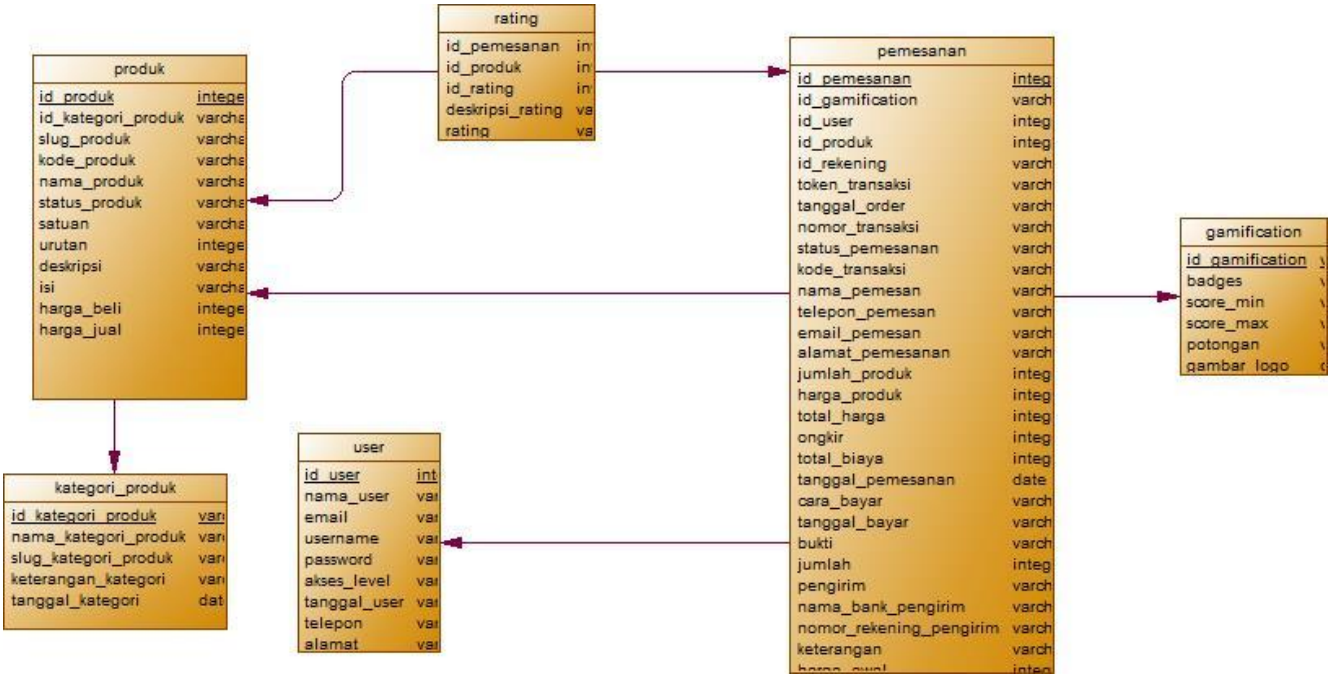
Gambar 3. *Context Diagram*



Gambar 4. *Data Flow Diagram Level* 0



Gambar 5. *Data Flow Diagram Level* 1



Gambar 6. *Physical Data Model.*

Physical Data Model

Entity Relationship Diagram adalah diagram yang digunakan untuk perancangan model suatu *database* dan menunjukkan relasi antar entitas atau objek. Terdapat dua model yaitu *Conceptual Data Model* (CDM) dan *Physical Data Model* (PDM), yang dapat dilihat pada Gambar 6.

Construction

Pada tahapan *construction* berisikan tentang membuat sistem pengkodean yang dapat dikenali oleh komputer. Penggunaan komputer dimaksimalkan pada saat ini.

Deployment

Tahapan *deployment* adalah tahapan terakhir dari pembuatan sistem. Setelah dilakukan analisis, desain, dan pengkodean maka sistem yang sudah jadi akan digunakan oleh *user* serta terdapat *maintenance* secara bertahap. Tahapan ini tidak dapat dilakukan dikarenakan keterbatasan waktu oleh peneliti. Pada tahap pengujian *black box testing* berfokus pada persyaratan fungsional perangkat lunak, sehingga pengujian memungkinkan perangkat lunak untuk meraih kondisi *input* yang sepenuhnya akan menjalankan semua kebutuhan fungsional dalam suatu *program*.

HASIL DAN PEMBAHASAN

Perhitungan *Gamification*

Dalam penerapan perhitungan poin terdapat keterkaitan elemen, *point* didapatkan ketika pelanggan melakukan transaksi pembelian dan memberikan konfirmasi serta ulasan produk setelah sudah selesai melakukan transaksi. Setiap pembelanjaan senilai Rp. 2.000 pelanggan akan mendapatkan 1 poin. Perhitungan *point* dapat dilihat pada Tabel 5.

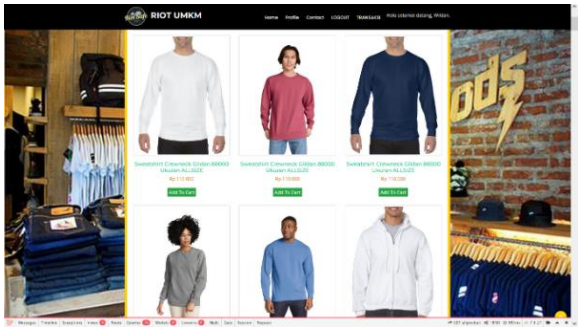
Tabel 5. Perhitungan *Gamification*

No	*Badges*		*Point*		Diskon
1.	*Bronze*	:	50–500 poin	=	2%
2.	*Silver*	:	1000 poin	=	4%
3.	*Gold*	:	1500 poin	=	6%

Perolehan *point* dan *badges* yang sudah didapatkan oleh pelanggan tidak akan direset apabila *reward* atau potongan harga yang didapatkan sudah digunakan untuk pembelanjaan. Dengan minimal pembelanjaan Rp. 100.000, - pelanggan sudah mendapatkan *badges* sesuai ketentuan yang berlaku.

Transaksi penjualan

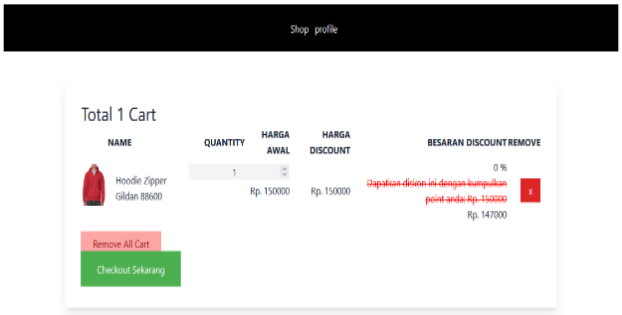
Implementasi ini adalah halaman yang menggambarkan tampilan produk pada Gambar 7.



Gambar 7. Tampilan Produk

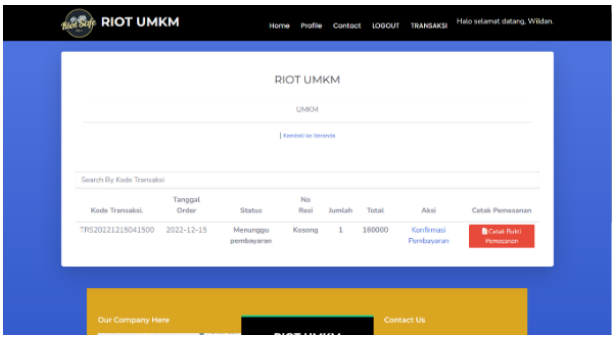
Pemesanan produk dimulai dari pelanggan memilih produk dan tekan tombol *add to cart*. Setelah itu pelanggan bisa melihat produk yang sudah dipilih, melihat harga awal, harga diskon, serta besaran diskon dengan menekan tombol detail keranjang seperti Gambar 8. Pemberian diskon dilakukan agar pelanggan

tertarik untuk membeli produk, karena diskon berpengaruh secara simultan terhadap variabel keputusan pembelian produk[13].



Gambar 8. Keranjang

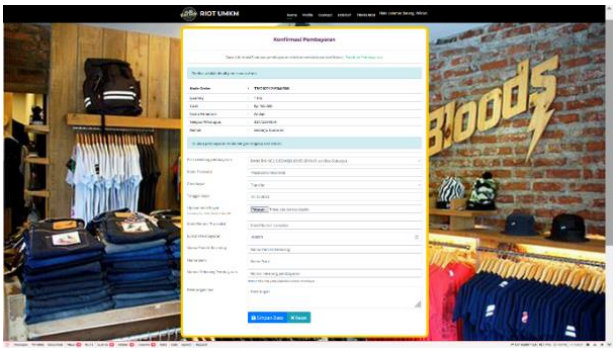
Setelah itu pelanggan menekan tombol *checkout* sekarang, untuk melakukan pemesanan. Pelanggan menekan menu transaksi yang akan di arahkan ke proses transaksi selanjutnya seperti Gambar 9.



Gambar 9. Menu Transaksi Penjualan

Pembayaran

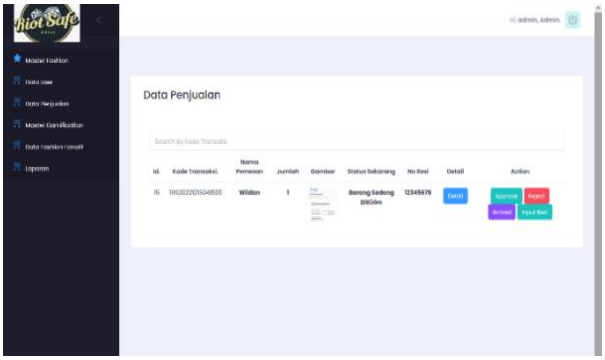
Implementasi ini pelanggan menekan tombol konfirmasi pembayaran yang akan mengarahkan ke halaman konfirmasi pembayaran seperti Gambar 10.



Gambar 10. Menu Pembayaran

Verifikasi Admin

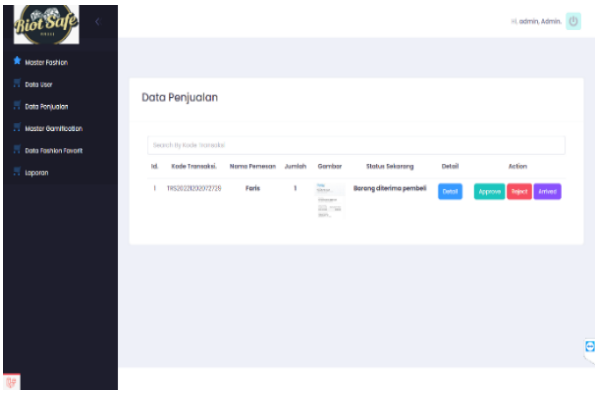
Implementasi ini admin melakukan pengecekan pembayaran yang sudah dilakukan oleh pelanggan, dengan menekan tombol detail untuk melihat bukti pembayaran apakah sudah valid atau tidak. Jika sudah *valid* maka admin menekan tombol *approve* untuk mengubah status seperti Gambar 11.



Gambar 11. Tombol *Approve* Untuk Perubahan Status

Pengiriman Barang

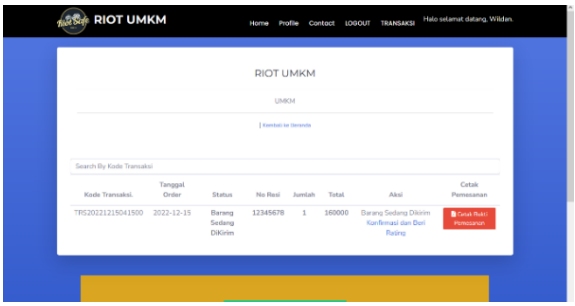
Setelah produk terkirim ke pelanggan, maka admin akan menekan tombol *arrived* untuk mengubah status jika pelanggan tidak melakukan konfirmasi barang diterima diperlihatkan pada Gambar 12.



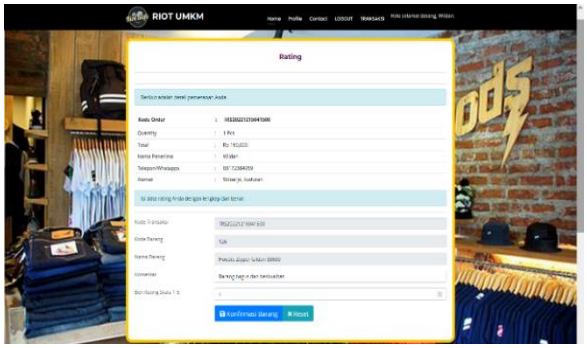
Gambar 12. Menu Pengiriman Barang

Ulasan Produk

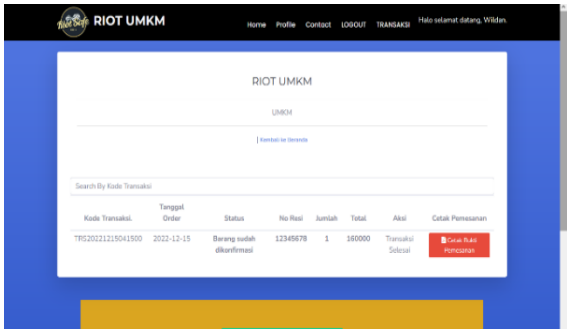
Implementasi ini pelanggan melihat ada perubahan status menjadi barang diterima pembeli. Apabila produk sudah sampai pada pelanggan, maka pelanggan menekan tombol konfirmasi barang telah diterima pada Gambar 13. Pelanggan akan masuk ke halaman *rating*, untuk memberi komentar dan memberi penilaian sesuai ketentuan toko pada Gambar 14. Kemudian pelanggan menekan tombol konfirmasi barang untuk menyelesaikan pembelian produk pada Gambar 15.



Gambar 13. Menu Konfirmasi Barang Diterima



Gambar 14. Menu Pelanggan Memberi Komentar dan *Rating*



Gambar 15. Menu Transaksi Selesai

Pengujian Fungsi dan Kesesuaian Aplikasi

Uji coba fungsi aplikasi penjualan *online* ini dengan metode *Black Box Testing* diperlihatkan pada Tabel 6. Pengujian fungsi aplikasi dengan *Black Box Testing* untuk mengetahui apakah algoritma yang dipakai berjalan sesuai dengan yang ditentukan atau tidak, dan apakah fungsi, masukan dan keluaran dari perangkat lunak sesuai dengan spesifikasi yang dibutuhkan [13]. Hasil pengujian dengan metode *Black Box Testing* diperoleh bahwa semua fungsi dari aplikasi telah berjalan dengan baik.

Tabel 6. Hasil Pengujian

No	Kasus *Testing*	Skenario	Hasil yang diharapkan	Hasil Pengujian
1	Menampilkan semua produk	Memilih barang	Data detail barang berhasil tampil	sesuai
2	Menambahkan barang ke keranjang	Memilih barang dan menekan tombol *add to cart*	Data barang berhasil di tambahkan ke *cart*	sesuai
3	Melakukan *checkout* barang	Menekan tombol *checkout* sekarang	Menekan tombol *checkout* sekarang	sesuai
4	Melakukan pembayaran	Menekan tombol konfirmasi pembayaran	Berhasil masuk ke halaman konfirmasi pembayaran	sesuai
5	Melakukan konfirmasi pembayaran dan *upload* bukti pembayaran	Mengisi data pembayaran dan *upload* bukti pembayaran	Data pembayaran berhasil ke data penjualan (admin)	sesuai
6	Menerima data konfirmasi pemesanan (admin)	Menekan tombol *approve*.	Berhasil mengubah status menjadi pembayaran *valid*.	sesuai
7	Masukkan nomor resi (admin)	Nomor resi masuk ke dalam tampilan menu transaksi dan tampilan data penjualan pada admin	Berhasil mengubah status menjadi barang sedang dikirim.	sesuai
8	Menerima barang diterima (admin)	Menekan tombol *arrived*.	Berhasil mengubah status menjadi barang diterima pelanggan	sesuai
9	Melakukan konfirmasi dan ulasan produk	Menekan tombol konfirmasi dan beri *rating*, kemudian mengisi komen dan *rating*, menekan tombol konfirmasi barang	Data ulasan produk berhasil disimpan, mendapatkan *point*, dan mengubah status menjadi transaksi selesai.	sesuai
10	Menampilkan *badges* dan perolehan *point*	Masuk ke halaman detail produk, menampil	*Badges* dan perolehan *point* berhasil di tampilkan	sesuai

No	Kasus *Testing*	Skenario	Hasil yang diharapkan	Hasil Pengujian
		kan *badges* dan total perolehan *point*		
11	Menampilkan *leaderboard* (*point* tertinggi)	Masuk ke halaman data *dashboard* yang terdapat grafik perolehan *point* pelanggan tertinggi dan ulasan produk	Berhasil menampilkan grafik dan ulasan produk	sesuai
12	Menampilkan *reward*	Menampilkan potongan harga jika sudah *login*	Berhasil menampilkan potongan harga	sesuai
13	Menampilkan laporan penjualan	Menampilkan laporan penjualan	Berhasil menampilkan laporan penjualan	sesuai

Selain pengujian fungsional, juga dilakukan pengujian dengan *User Acceptance Test* (UAT) dengan membagikan kuesioner kepada 5 orang pengelola Riot Safe dan 25 pelanggan. Hasil pengujian menunjukkan bahwa 100% pengelola menyatakan bahwa aplikasi sudah sesuai untuk mengelola transaksi secara *online*. Sebanyak 97% pelanggan akan menggunakan aplikasi karena adanya sistem poin, sedangkan 93% pelanggan akan terus berbelanja menggunakan aplikasi karena mendapatkan potongan harga. Berdasarkan hasil UAT dapat dikatakan bahwa aplikasi penjualan yang dihasilkan sudah sesuai dengan kebutuhan pengelola Riot Safe. Sedangkan bagi pelanggan, aplikasi dengan metode *Gamification* tersebut akan meningkatkan aktivitas berbelanja. Hal ini akan berdampak pada peningkatan jumlah penjualan pakaian polos di Riot Safe.

KESIMPULAN DAN SARAN

Kesimpulan yang dapat diambil dari hasil penelitian berupa aplikasi penjualan *online* meliputi halaman utama yang menampilkan semua produk, pemilihan produk, transaksi penjualan, pembayaran, pengiriman barang, ulasan produk, laporan penjualan, dan tampilan berdasarkan metode *Gamification*. Fitur pada *Gamification* dapat memicu pelanggan untuk aktif berbelanja dengan adanya pemberian poin pada setiap transaksi yang dapat digunakan untuk mendapatkan potongan harga. Sebagai upaya mempermudah pelanggan dalam bertransaksi. Hasil pengujian aplikasi kepada 5 orang pengelola Riot Safe dan 25 pelanggan menunjukkan bahwa 100% pengelola menyatakan bahwa aplikasi sudah sesuai untuk mengelola transaksi secara *online*, 97% pelanggan akan menggunakan aplikasi karena ada sistem poin, dan 93% pelanggan akan terus berbelanja menggunakan aplikasi karena mendapatkan potongan harga. Aplikasi penjualan *online* ini dapat dikembangkan menjadi aplikasi berbasis *mobile*.

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The Existence of Artificial Intelligence in the Future

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Abstract: *Artificial intelligence is arranged and communicates in a language structure to have a machine learning algorithm that picks up the faster solution in solving humanity's problems. However, the separation between good and bad all comes down to the human's intention and determination. Hence, it is crucial to look at the data patterns and come out with the most appropriate machine algorithm. The layering of nodes and information is forming to create a piece of new knowledge. It is a universal language algorithm that speaks with one another to convey the same message. In other words, dimensionality and data simplicity lure in more knowledge and understanding of the problem.*

Keywords*: Dimensionality; Language Structure; Machine Learning*

INTRODUCTION

[1] reported that based on a recent PricewaterhouseCoopers (PwC) study, there are more than fifteen trillion U.S. dollars of artificial intelligence (AI) expenditure in the global economy by 2030. However, [1] proclaimed that 35 percent of global organizations attempted to incorporate AI in their daily business activities. Hence, [1] presumed that AI should be broadened and widened in their field of expertise.

It goes as Bonnefon and Rahwan [2] stated that folk theories emphasized how humans think can powerfully shape and modeled how the machines were made and extensively perceived by the users. Artificial intelligence is more to machines that can operate and communicate with other beings. It is different from human intellectual ability and common sense to make up their minds. In an organized manner, machines can perform tasks, such as problem-solving. Artificial intelligence attempts to copy and imitate human behaviors by coding and programming instead of making their own decisions. Artificial intelligence manages to conduct and handle massive and surmount tasks to surpass humans' capabilities. Nowadays, many decision-makers are moving forward with artificial intelligence.

In terms of education, artificial intelligence is over the top. Students can experience and get inspired by the latest invention and technologies. Artificial intelligence also assists students in tutoring and helping them with their understanding to be more imaginative in their classrooms. For instance, Yara et al. [3] discovered the non-profit organization Enlearn from Seattle has developed an interactive educational platform operated under machine learning in speeding up their learning process. Hence, Yara et al. [3] found Ministry of Education and Science of Ukraine had made it work but safety comes first. Artificial intelligence will also reduce labour in manufacturing. Manufacturing involves a surplus amount of product lines that require strength and time. In this case, Saxena [1] added the main facility for the manufacturing sector is robotic process automation, including robotic assembly, and robots repairing damaged or malfunctioning systems. In return, human mistakes, system failures, and defectiveness of the product can be reduced and improved.

Other fields require artificial intelligence as well. They can be peacemakers, law justifications, and entertainment industries. Not only capable of having artistic taste and fair judgment but also having a sense of humanity. For instance, logical reasoning for handling human cases at the court. Intelligence is the opposite of ignorance. Artificial intelligence also holds for the future. Artificial intelligence also can be a part of humanity, but it is also emotionless at the same time. From a global perspective, artificial intelligence is a companion to humans, but one should not replace their trust and loyalty. It can be very promising, but in the end, humans decide what is best for them.

Based on DoubleClick for Publishers [4], AI also has a hidden talent but not by mimicking instead learning how humans got their hands in the art world by practicing and expressing even without having feelings and emotions to make sense of it. Remarkably, the word generative artificial intelligence is mentioned by Agence France- Presse Relaxnews [5] to be assigned in the design sector which drastically evolved with imagining tools, such as Dall-E 2, Imagen, DreamBooth, and Stable Diffusion producing interactive images generated from the written scriptures of instructions. Yara et al. [3] opened up about the authorship of music that can be proclaimed by the AI itself since the author has not contributed any creativity to the song. In the land of the United Kingdom which valued the artistic creativity of a certain artist, Yara et al. [3] claimed that the law is well-equipped with protection and ownership of machine-generated works to contain their originality.

The purpose of the review paper is to give an overview of the expanding and in certain circumstances even invasive scope of AI in its practical application.

As mentioned before, Burns [6] defined artificial intelligence as the simulation process of human intelligence using machines and computer systems. Otherwise, West and Allen [7] mentioned artificial

intelligence also incorporates and compiles information to conduct data analyses for human decision-making. In other words, Schroer [8] narrowed down artificial intelligence as a branch of computer science concerning the build-up of machines and computers which operate under human-structured orders. Generally speaking, Collins et al. [9], Turing [10], and McCorduck [11] in accordance with John McCarthy had defined and coined the word artificial intelligence as the science and engineering of making intelligent machines. Hence, Schroer [8] also defined it as an interdisciplinary science creating opportunities and advancements in the tech industry. In simple language, Kumari [12] stated God had given humans the intelligence to build machines. In other words, Kumari [12] also mentioned artificial intelligence obtains data and conveys information to humans to perform their tasks.

In the United States in 2017, West & Allen [7] and Davenport et al. [13] accumulated 17% of 1,500 senior business leaders who were still puzzled by the term artificial intelligence. West and Allen [7] added that they may realize the full potential of artificial intelligence in running a business but are still unaware of their ways of conducting it. Further, Schroer [8] discovered that continuous advancements in machine learning and deep learning seem to blossom in the tech industries.

The dynamic duo Stuart Russell and Peter Norvig studied the four basic approaches when defining artificial intelligence. They are separable based on the action of thinking and doing. The scopes are rational and have a sense of humanity. Artificial intelligence can think humanly or rationally and act humanly or rationally. However, Schroer [8] realized that humans are complex beings that can either be ignorant or irrational. Hence, the former Massachusetts Institute of Technology (MIT) professor of artificial intelligence and computer science, Patrick Winston, mentioned algorithms bounded by constraints are supported by looping models that combine thinking, perception, and action altogether.

Until now, Allen [14], Bhatnagar et al. [15], Brachman [16], Simon H. [17], and Nilsson [18] defended that there is still no definite meaning of artificial intelligence despite its longevity in various research fields. From a holistic view, Rai et al. [19] finalized the meaning of having the ability of a machine to perform cognitive functions that they associate with human minds, such as perceiving, reasoning, learning, interacting with the environment, problem-solving, decision-making, and demonstrating activity.

METHOD

A narrative review is implemented by dividing the general knowledge of artificial intelligence based on introducing the term, the cognitive process for artificial thinking, the functionality of the system, the history behind it, the gains and losses, and the future perceived by the users. Henceforth, the sections are narratively distinctive by the concepts of having AI. Hence, this review may disseminate and elaborate more on the contributions made by the AI itself.

Human Intelligence VS Artificial Intelligence

Thinking is an act of producing thought which requires an opinion or judgment. That is to differentiate between good and evil and to understand the outcomes. It is natural to think of the best way to survive danger. Compared to robots, there are more emotionless and indecisive depending on humans' attention at times. Not until Armstrong [20] referred to a group of researchers namely, Anastasiia Raina, Lia Coleman, Meredith Binnette, Yimei Hu, Danlei Huang, Zack Davey, and Qihang Li found that AI somehow managed to copy the behaviour of the brain’s neurons that is the first neural network developed to teach itself and improve over time with minimal to no human intervention.

Based on these statements, human thinking is different from machine thinking. Artificial intelligence is more than that. The human mind is like a sponge that absorbs information and memories as it exercises like a muscle that requires training to achieve its goals. Time is valuable. Imagine if artificial intelligence does the same by keeping and restoring information in time and abundance.

According to Kumari [12], there are seven fundamental differences between human and artificial intelligence as follows:

1. Humans make up their minds. By dealing with figures and numbers, humans discover more and increase their knowledge to understand real-world problems.
2. Hence, artificial intelligence is dependent on the data to finalize the answer. Unlike humans, they have logical thinking for rationality and reasoning.
3. History makes your day. It is a reality for humans to learn and recall their past mistakes. The given information is in the present, so artificial intelligence can only pick up what is already for them.
4. For coping and adapting, humans are more capable than artificial intelligence but require adjustments to the new environment.
5. Artificial intelligence consumes less energy than humans. Human brainpower consumes more power than physical labor.
6. Humans are slow when processing information as compared to computers until now.
7. Humans are better companions than artificial intelligence by excelling in social interactions and interpersonal skills.

Overall, Collins et al. [9] found AI is achieved in separate ways to achieve different goals in terms of structure, behavior, capability, and function which are relatively operated and functioned using the same human brain. Hence, Collins et al. [9] added intelligence does not belong to any biological beings but is also referred to as a general notion to impersonate the mind itself artificially even for robotic inventions as well.

Henceforth, Bonnefon and Rahwan [2] perceived the rough idea of having a fast and slow

thinking process which is a dual process to differentiate between intuition and reason. Humans can come out with their own intuitions and reasons even for others but artificial intelligence is more of the word reasoning with provided logical thinking behind it. Further, Armstrong [20] quoted from John Zimmerman, Professor of Artificial Intelligence and Human-Computer Interaction, at Carnegie Mellon University that it is difficult to predict intuition. So as, the involvement of others, humans tend to care and appreciate others' help and care for their individual or group needs. Artificial intelligence is not far behind as nowadays humans wanted to give life to the machinery world in having a meaningful community. This is what is called by Bonnefon and Rahwan [2] implementing intuitive and reflective processes. As mentioned by Bonnefon and Rahwan [2], artificial intelligence should also learn from the perspective of others in the act of cultural and background differences. Bonnefon and Rahwan [2] described it as having metacognition machines which is the way human cognition is projected onto machines. However, time for speed is the amount of information gathered between humans and artificial intelligence that is measured to be compared with each other. Then, Armstrong [20] added all an algorithm does is make predictions and probabilities.

Fast thinking involves a rapid and quick response to a certain situation that requires a thoughtful act to be carried out. Slow thinking instead of taking a shortcut requires a more careful and arranged set of behaviors to react in a kind of way. In this case, the features and criteria for differentiating between both systems can be elaborated more by Bonnefon and Rahwan [2] as shown in the following table.

Table 1. The Distinguished Parts Fast and Slow Thinking

Thinking Systems	Fast Thinking	Slow Thinking
Information containment	A large amount of information with less effort.	A small amount of information can be processed at a time.
Set of rules	Implicit and provide ideal solutions in a timely manner.	Explicit rules are set in with invisible reasons.
Type of roles	Off track and become reliant on the usual, normal, and familiarity.	With careful inspection, there is a corrective role.

It seems as if both thinking skills whether it is fast or slow are compromising for different fields of study. Bonnefon and Rahwan [2] mentioned in the engineering field they are able to differentiate between heuristic and analytical reasoning. Heuristic is a simplification of the complexity of problems to minimse the overload of thinking independently. In a user experience, Bonnefon and Rahwan [2] summarized slow thinking is known to be objective and fast thinking is more subjective. Bonnefon and Rahwan [2] and Castelo et al. [21] understood some machines may think fast making them conceivable for subjective tasks. Bonnefon and Rahwan [2] found slow thinking machines conduct themselves at their own will without human interference. Further, Bonnefon and Rahwan [2] and Kupor et al. [22] notified some intelligent machines operated under both thinking modes for their daily operations. Accordingly, Saxena [1] found that the so-called intelligent machines manage to replace smart devices, including smartwatches, smart televisions, smart appliances, and smart thermostats which are commonly known as the Internet of Things (IoT).

How Does Artificial Intelligence Work?

At a preliminary level, Saxena [1] noticed every human endeavor generates data. Preoccupied with data management, Saxena [1] added a manageable data comes with the right strategic business operations, goals, and priorities. Saxena [1] underlined data quality to be checked and diagnosed first before implementing AI and machine learning. Burns [6] and Kumari [12] summarized that artificial intelligence deals with training data, analyzing patterns, and correlations to make future predictions. The so-called training data as referred to by Armstrong [20] will be initiated first before training models are utilized in machine learning. Thus, Kumari [12] explained artificial intelligence may be more precise and accurate than humans in analyzing data and producing results, but humans are the pioneers in technology. Saxena [1] exclaimed that in this revolutionary era of big data, both structured and unstructured data are the underlying patterns and behavioral analyses for consumers' preferences and business environments. It is discovered by Burns [6] states that artificial intelligence interacts with humans to meet their needs for image recognition tools. Then, Kumari [12] added it can be done by basic reasoning behind it. Further, Burns [6] elaborated there are three cognitive skills that artificial intelligence requires to keep in touch with humans, such as learning, self-reasoning, and self-correction. In business, for instance, Saxena [1] proposed that unraveling the data value comes with a long-lasting business impact.

The first step as identified by Burns [6] and West and Allen [7] is the learning process involving algorithms using numbers and calculations to conduct a specified human task. Then, Burns [6] ensured that the selected algorithm will do the job of obtaining the most accurate results. Collins et al. [9] added artificial intelligence is at another level of cognition involving a learning process as proposed by Langley [23] as follows:

1. Multi-step reasoning
2. The meaning of natural language
3. Innovative artifacts
4. Novel plans that achieve goals
5. Reason out their actions

Based on these steps taken, Kurzweil [24] referred the artificial intelligence as a general human-like intelligence classified as strong AI. Instead of relying only on chatbots and virtual agents to have quick and imminent responses, Collins et al. [9] also brought up the human-agent interaction which is also known as hybrid knowledge. The term hybrid knowledge as discovered by Collins et al. [9] is used to describe the knowledge gained through physical and virtual meetings among each other by compiling between the two to have real experience in the outside world. Besides that, Collins et al. [9] studied business values that may fully develop from the different stages of maturity.

According to Saxena [1], there are four types of data analytics that are in the form of descriptive, diagnostic, predictive, and prescriptive. The first one is considered by Saxena [1] to be descriptive in nature based on historical data. As for the repetitive use of data, Saxena [1] classified it as diagnostic analytics. Then, Saxena [1] mentioned predictive analytics rely on probability, not certainty which soon develops into prescriptive analytics that makes concluding remarks based on the predictive results.

To put into work, Saxena [1] studied for algorithm made by the Netflix business for movie watchers even for a huge crowd of audiences which found to be accessible during the pandemic somehow manage to keep its' originality content and get satisfying reviews from online streaming of tv shows and movies. From the basic calculation of correlation analysis, Saxena [1] reported the smallest detail as in the thumbnails images from different movies are strongly correlated with a tv show or a movie.

History In Making

During the Industrial Revolution, human labor and capitalism were on top of business productivity. The diversification of the human economy creates job opportunities as part of survival. Not until pioneers come out with automotive skills to help create robots and automatic machines to assist humans doing the laborious jobs. Thus, Armstrong [20] discovered the function of capitalism in implementing something new to engage with the customers.

Schroer [8] started off with the breaking code of enigmatic made by Alan Turing over a decade ago for Allied forces in the Second World War. It turns out successful, thanks to Alan Turing becoming the first human to break the code. Schroer [8] also summarized that it all comes down to his question of whether machines can think.

Saxena [1] dated back to the 1950s when robots made their debut but were missing components of big data and artificial intelligence. In the 1950s and 1960s, as recalled by Saxena [1], companies operated using large mainframe computers. Despite their outstanding achievement during that time, Saxena [1] stated that there is a limitation in storage capacity and a slower micro processing system. However, Saxena [1] studied Moore's Law which envisioned that machines tend to become smaller in size and have a bigger storage capacity to give more room for analyzing the larger size of data. That is, in the 1970s, Saxena [1] added Gordon Moore estimated computer processing speeds or power will double every two years. As indicated by Armstrong [20], there is a long history of incorporating human emotions and behavior into non-human entities.

Hence, Armstrong [20] mentioned the development of AI consumed most of history time. Beforehand, in 1964, Joseph Weizenbaum invented an early natural language processing computer program, ELIZA, at the Massachusetts Institute of Technology (MIT) located at the Artificial Intelligence Laboratory which is an early chatbot to form a simple pattern matching to simulate basic conversational responses to a user. In the present time, in 2019, Schroer [8] referred to a paper entitled "One the Measure of Intelligence" stating how a veteran deep learning researcher and Google engineer, Francois Chollet debates intelligence learned through experiences that then develop into valuable skills for future prospective. Thus, Armstrong [20] added the main branch of AI during that time is machine learning. As clarified by Saxena [1], Starbucks is not a company but a data company that sells coffee. This shows that business momentum is not holding on to a certain commodity offered, such as food and beverages, but can also give more satisfying services to the customers based on their personal customization and preferences. In fact, Saxena [1] mentioned the humanoid robots which learn, and study human behaviors based on a sufficient amount of data.

The Benefits and Risks of Artificial Intelligence

As mentioned by Bonnefon and Rahwan [2], machines may assist humans in the approval of bank loans, the determination of a defendant to get parole, managing kidney transplantation, and in driving which signaled the driver to speed up in a jiffy when facing obstacles along the road. On the road, Yara et al. [3] and managed to explain the cooperation between AI and the Traffic Organization Center of Ukraine to calculate and analyze the behavior of cars including the number of cars in a traffic jam and the number of vehicles by the direction of movement, depending on the time of the day and other influential factors. Then, Saxena [1] added in an autonomic system of a vehicle, AI had the sensibility to correct error codes to avoid dangerous situations while on a highway. Instead, Saxena [1] even mentioned having shortcuts or alternative routes to shorten the distance for the car to reach its destination. In this case, Armstrong [20] portrayed AI as a human navigation system to guide them in reaching their destinations.

Bonnefon and Rahwan [2] added ethical standards need to be addressed in the final touch. Bonnefon and Rahwan [2], Wong [25], and Srivastava et al. [26] viewed it ironically as humans tend to think too slowly when applying corrective measures to improve the ethical issues faced by Fast Thinking machines. Bonnefon and Rahwan [2], Mercier and Sperber [27], and De Neys [28] also explained that rationalization is one of the psychological perspectives owned by humans when making their judgments to be put in use for

building machines in the era. Steels and Brooks [29] unraveled in 2015 that Bill Gates was well-versed in artificial intelligence, but it can be a warning to humankind for being exposed to the overdevelopment of artificial intelligence systems. It sounds difficult as soon as Stephen Hawking describes that artificial intelligence will end the human race. Elon Musk, the founder of Tesla and SpaceX shares the same statement. Thomas [30] enlisted the potential risks that surround artificial intelligence until now as follows:

1. Automation layoffs. In other words, Armstrong [20] depicted the word deskilling of humans. As mentioned by Chadha [31] and Saxena [1], there should be a balance between automation and growth without leaving behind loyal employees. Chadha [31] suggested holding back on automating until there is a comparison of growth rates being made in the business. Hence, Chadha [31] reasoned out by giving room to them is another welcoming strategy for having a long-term strategy and reducing the speed of automation. Remember humans are better adapters than artificial intelligence which may cope and strategies with the automation process.
2. Thomas [30] dated back in 2018 and reported social violation is ranked as one of the top dangers of artificial intelligence. For instance, Thomas [30] depicted TikTok as the most widely anticipated social network to ever be used for a political purpose in Filipina. People need to be careful when expressing their viewpoints in public especially when involved in their personal lives. Another example as referred by Thomas [30] is that TikTok's artificial intelligence algorithm tends to trace back and filter out some harmful and inappropriate media to be shared among the users. Hence, one after another caused some misunderstandings or misperceptions about a certain subject that seems to violate their privacies and intricacies at the same time.
3. Micro scoping other people's lives is against the law. The involvement of social surveillance uncovered by Thomas [30] can also be referred to as a criminal act to violate one's privacy and security. Instead, monitoring people in public places also requires personal data to be collected which seems to be too overcontrolled or overprotective up to the point that might also endanger their lives.
4. Then, Thomas [30] added artificial intelligence is also biased against gender and race. Stereotyping and other types of biases may influence the viability or appropriateness of artificial bits of intelligence algorithms in measuring humans' capabilities. Even artificial intelligence would not recognize their talents and skills in improving themselves to achieve their dreams.
5. Due to earlier unfairness and discrimination, this may lead to other problems. As mentioned before, the talent pool and the growth of communities are unable to be measured and analyzed by artificial intelligence. Hence, Thomas [30] had the idea of having artificial intelligence in assisting humans to overcome social boundaries or create job opportunities seems to be far-fetched until now.
6. Push over the boundaries seems to be overboard this time. Some law enforcers or lawmakers tend to make their lawful statements to be decided by artificial intelligence. To follow blindly artificial intelligence interpretations and predictions without firm belief or justification, may pose a great risk to humanity across all ages.
7. Overly and freely automated artificial intelligence without human interference is a risky situation. This may include hacking systems and cyberattacks that are invaders to the computerized system to handle and control their operations. By handling them in proper hands, there is less risk and danger, to begin with.

There are economic challenges when it comes to artificial intelligence. This is because Thomas [30] studied the consequences of having investors become even timider and unconfident when dealing with the current financial situation. As known by Thomas [30], artificial intelligence may decide for the financier to make the profitable or riskier decision when handling the monetary future. But still, they need to be well-equipped by knowing how to decide by using their artificial intelligence.

The Charlotte Observer/ Tribune News Service [32] referred to Better Business Bureau in finding out the most recent cybercrimes, such as phishing, impersonation, and romance scams that took advantage of personal information posted online on social networks. For instance, The Charlotte Observer/ Tribune News Service [32] studied scammers who interfered with businesses online, including Amazon which falsely proclaimed to change their account website forcing them to create a new profile when signing up.

One of the ways to mitigate the risk is to have a balanced relationship between humans and artificial intelligence. The way we attach and interact with artificial intelligence plays a vital role in having a more meaningful mechanistic relationship with each other. It all depends on their intentions and wants which could not easily influence the way they are making their decisions and plan for their future as well. Artificial intelligence hopes to have remained compatible and engaged in human lives which assists them in doing laborious work and timely behaviour. As a community, it is crucial to have the knowledge and tools in improving themselves by using artificial intelligence in their daily lives. It does not mean that humans must stick to their old-fashioned ways of doing their business and continuing doing what they are doing but also to be able to expand their knowledge and curiosity towards the future of the people.

Hence, The Charlotte Observer/ Tribune News Service [32] is expected to have a lookout for suspicious content when using online services by following the steps as shown below.

1. Be cautious of unsolicited messages.
2. Asking for contact information for verification.
3. Labeled as red flags.
4. Authenticate personal account.
5. Generate a strong password.
6. Make sure of the originality of the website before downloading files or clicking on links.

The Future Perspectives of Having Artificial Intelligence

One of the prospects of artificial intelligence is the increased number of job layoffs. Edubirdie [33] accounted for what Forrester wrote an article on 'The Future of Work' which predicts by 2030 that job losses will reach a rate of 29 percent equivalent to roughly 20 million jobs with an even lesser job creation which amounted to 13 percent. This is because Edubirdie [33] escalated that most projects are dealing with hands-on artificial intelligence especially data entry, inventory trackers, proofreaders, and receptionists. Nowadays, even practical training is replaced by automated machines and vehicles for high performance and cutting edge.

Artificial intelligence is also a medium for humans to further discover and explore new inventions and hidden places even in space. For instance, Edubirdie [33] mentioned Lawrence Berkeley National Laboratory can predict thermoelectric materials by using artificial intelligence. According to Edubirdie [33], it does not only stop there since the technology also advanced in 2017 after discovering a shocking exploration involving the National Aeronautics and Space Administration (NASA) which discovered the eighth planet in the solar system using the technology of artificial intelligence. Then, in 2019, Edubirdie [33] also found another two planets discovered by astronomers at the University of Texas. This also includes what Agence France- Presse Relaxnews [5] has found that NASA also put in a lot of effort to master the design of a Preserverance rover in bringing back the Earth's soil from the Red Planet called MARS as a sample.

In terms of healthcare, Edubirdie [33] remained at a standstill as it does not take years and effort for artificial intelligence to suggest some preventive measures to put a halt to any such epidemic occurring in the world. As mentioned by Edubirdie [33], in the healthcare sector, artificial intelligence got the chance to study the underlying patterns of diseases, diagnoses, and treatments based on several sets of data. It was later explained by Edubirdie [33] that life expectancies, the onset of diseases, improvement in drug trials, and becoming an assistant to a doctor for detecting and diagnosing symptoms of a certain kind of disease. Agence France- Presse [34] encountered Garmi as a doctor's assistant in remote communities in Germany to keep on track of the health progress and look for data updates on their personal health profiling to keep their betterment in health. For their healthcare support, Agence France- Presse [34] cherished their family and friends that are always in their minds and hearts for their journey of recovery with the brought-up AI in their hands. But Edubirdie [33] continuously uncovered that the so-called nanotechnology collaborated with artificial intelligence to identify bad cells in cancer patients for tumor penetration and drug distribution.

There is a need to have a humanoid robot as a friend in the future. As well as; Armstrong [20] emphasized the empathic relationships with AI by observing their relationships with lifelike robots. Edubirdie [33] described the process of having caregivers or home companions as future caretakers. Edubirdie [33] is aware of their extension to record and convey meaningful information to have intelligent conversations, prepare healthy meals, and smoothen the daily average of human activities at the same time. That is mentioned by Armstrong [20] that there is a possibility of blending AI intelligence with human interpersonal skills. The latest one is to develop an emotion AI in detecting their feelings and emotions using a neural network of mappings onto their connected nodes in determining the positivity or negativity vibe received by the researcher. Saxena [1] referred to it as artificial emotion intelligence also known as affective computing made of sensors, cameras, and deep learning to interpret human emotions after seeing movies or engaging in any educational activities. Yara et al. [3] measured the possibility of measuring human emotions under psychological indicators, such as pulse and body electrical impulses. However, Armstrong [20] also reminded them that the machine's ability to read and interpret human emotions may take time to rejoice.

In Japan, there is drastic and progressive changes had been pointed out by Yara et al. [3] in the law-making procedures using AI. In criminology, Yara et al. [3] studied the use of software "Cassandra" incorporated with the elements of AI that analyses the repeated violations which broke the law. Yara et al. [3] also come across the same law enforcement introduced by another AI program known as COMPAS designated for certain states of the United States of America including New York, California, Florida, and Wisconsin. Due to the heap amount of criminology and correctional practices that are still expanding until now, the software programs have yet to be evaluated and implemented again in the future. Thus, Yara et al. [3] and Yong [35] suggested that software programs can be assessed in three ways, such as the risk assessment of general recidivism, violent recidivism, or the possibility of escape modeled in an algorithmic computerized system with some adjustments under the law. However, the profiling system of a suspect remains undetectable and unrecognizable as there is a weakened system in the identification records. Further, Yara et al. [3] found the fallibility and impairment of AI due to the non-linearity and heterogeneity of other data making it impossible to build an efficient algorithm. As mentioned before, Yara et al. [3] also referred to the impairment as a human mistake also related to cognitive biases. Eventually, Yara et al. [3] stated that AI is not vulnerable to these kinds of mistakes that provided humans with eligible objective results when analyzing a complex set of facts in making

more definitive and rational decisions. For instance, Fam [36] mentioned the application of Chat-GPT in the Law sector for supporting well-structured clauses provided with concrete evidence to finalize their statements in court.

According to Fam [36], the Generative Pretrained Transformer 3.5 (GPT- 3.5) language model is popularized as a chatbot that provides human-like responses for generated questions by the user. However, it is more like a prototype and unready made since it provided responses that required further evidence to support its statements. Fam [36] added even if the company runs wholly on Chat-GPT, it really needs some refinements in supporting its business growth. Then, came along GPT-4 which may replace internet search engine tools aligned with digital books and online texts to provide the most accurate answer in assisting humans to make adjustments in their daily lives. Associated Press [37] given their word as GPT-4 is also ethical when answering extreme questions, such as making explosions to endanger people's lives by halting the system from responding to such questions.

RESULT AND DISCUSSION

Artificial intelligence is the advanced stage of accumulating knowledge on the making process of having human thoughts and beliefs to be put into action. Neuroscience is referred to as the structure or function of the nervous system and brain [38]. Neurobiology is the study of nerve and brain function [38]. Nerves are impulses that were triggered by the brain or spinal cord to be transmitted to the muscles and organs [38]. It shows that the simulation of a computer system enhanced the chances of being able to think like a human brain after undergoing cognitive processes. Besides that, interdependence between humans and machines can be balanced by having both human and artificial intelligence to help build a better ecosystem. It all started with the Turing- powerful intelligent systems [38] and [39]. This shows that the most recent build-up models may embrace the technicality of the human brain [38].

However, humans should have full responsibility when handling the future technology of AI. It is not an argumentative statement. It all starts with humans who are creating artificial intelligence until now in different genres from different backgrounds. It also includes human rights and ethical standards to meet their specifications. Based on the findings, humans are still searching for the truth, especially when they are also curious in looking up information about the end of the day on planet Earth.

By putting full trust in AI, humans' imaginations are running wild without thinking about further consequences and outcomes of it. In fact, AI does put some effort into it but it would not last long when it comes to the unknown. Further, AI is more technical, and machinery works rather than draining out ideas and opinions to weigh in, especially for business adjustments.

To earn trust, an AI system should avoid any potential bias and discrimination for the protection of human equal rights. Unequal rights may lead to unjustifiable legal actions, especially in employment, economic mobility, and economic growth. So basically, by practising good sampling and data collection methods, there will be a representative sample to generalise the outcome of the study. In this case, AI with good training data will increase the confidence to have a reliable predictive model employed by machine learning.

The word certainty is highly expected in this uncertain world. Hence, this can be measured by consistent probabilistic events. That goes for not underestimating the dangers of errors in machine learning models as well. The errors, in this case, can be referred to as a failed output for the outcome of the study.

Despite the harmful effects of AI, there are several challenges to be tackled. Therefore, AI systems may profoundly have data to be trained in producing more precise and accurate results. Besides a number of misidentifications using facial recognition, an enhanced AI may assist to take it to another level.

CONCLUSION AND SUGGESTION

There are both positive and negative impacts of artificial intelligence on their precious lives. Ethics and morality should also be looked into although artificial intelligence operates on its own. Safety first. The privacy and security of public users should not be invaded and violated since their personal data are out in the open. As mentioned by Yara et al. [3], from now on, the protection of personal data, information protection, intellectual property, and competition are on their shelves. This is followed by Saxena [1] emphasizing that AI is also viable for any misfit in attempting to access private and sensitive data. For instance, Saxena [1] found that bank branches tend to have AI for detecting any invalid users that invade the data breach for gaining information on bank accounts. After what the Agence France- Presse Relaxnews [5] has gone through specifically in the art and design concept universally intact with humans for them to achieve balanced and optimal results in harnessing their creativity.

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Pengembangan Aplikasi Donor Darah Palang Merah Indonesia Kota Batam Menggunakan Metode Waterfall

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Abstrak: Palang Merah Indonesia (PMI) Kota Batam sebagai lembaga yang bertanggung jawab atas pengelolaan proses donor darah di wilayahnya, menghadapi tantangan dalam efisiensi koordinasi, akses informasi, dan keterlibatan masyarakat dalam kegiatan donor darah. Penelitian ini bertujuan untuk mengembangkan aplikasi Donor Darah PMI Kota Batam menggunakan pendekatan metodologi Waterfall dengan tujuan meningkatkan efisiensi pengelolaan donor darah, mempermudah akses informasi terkait, serta memfasilitasi partisipasi masyarakat dalam kegiatan donor darah. Metodologi Waterfall digunakan dalam pengembangan aplikasi ini, melibatkan tahapan analisis kebutuhan, perancangan sistem, implementasi, pengujian, dan pemeliharaan. Aplikasi yang dikembangkan dirancang untuk memungkinkan PMI Kota Batam mengkoordinasikan donor darah dengan lebih efektif, memberikan informasi yang mudah diakses kepada masyarakat, dan memperluas jangkauan partisipasi dalam kegiatan donor darah. Produk yang dihasilkan diuji dengan menggunakan metode *blackbox testing* untuk mengetahui apakah fungsionalitas sistem dapat dijalankan dengan baik sesuai dengan skenario ujinya. Hasil yang didapatkan yaitu sistem dapat melakukan semua fungsionalitasnya sesuai dengan alur pengujian yang dilakukan atau pengujian fungsionalitas berhasil 100%. Kemudian dilakukan pengujian usabilitas dengan menggunakan kuisioner *System Usability Scale* (SUS) dengan nilai yang didapatkan yaitu 70.00 dimana jika dikorelasikan dengan skala *grade* aplikasi berada pada *grade* B yang menunjukkan skor tersebut cukup baik. Aplikasi yang dikembangkan bisa diterima oleh pengguna tetapi masih membutuhkan peningkatan.

Kata Kunci: Donor Darah; Palang Merah Indonesia; Sistem Informasi

Abstract: *In the medical field, having an adequate blood flow is essential to ensuring that patients receive prompt care. The Indonesian Red Cross (PMI) in Batam, the organization in charge of overseeing the blood donation procedure in the region, encounters difficulties with coordination effectiveness, information accessibility, and community participation in blood donation operations. In order to improve the effectiveness of managing blood donation, facilitate access to pertinent information, and encourage community engagement in blood donation activities, this project seeks to design the Donor Darah PMI Batam application utilizing the Waterfall methodology approach. This application is being developed using the Waterfall technique, which includes the steps of requirements analysis, system design, implementation, testing, and maintenance. The application created is intended to help PMI in Batam better coordinate blood donations, give the public access to information, and widen the range of people who participate in blood donation events. The final product is examined using the Blackbox testing methodology. The system may carry out all its capabilities in accordance with the sequence of tests that were run, according to the results that were acquired or to put in another way the functionality test was 100% successful. The System Usability Scale (SUS) questionnaire was used to conduct the usability test after that. The result was 70.00, which, when compared to the application grade scale, is a grade B, indicating that the result is fairly good. The generated applications are also usable by users but still require refinement.*

Keywords: *Blood Donation; Indonesia Red Cross; Information System*

PENDAHULUAN

Teknologi merupakan berbagai hal yang dapat meringankan aktivitas manusia. Berkembangnya ilmu pengetahuan dan teknologi saat ini menjadikan teknologi informasi sebagai aspek penting di kehidupan masyarakat serta bagian dari gaya hidup masyarakat *modern* sekarang [1]. Teknologi informasi yang dapat mempermudah aktivitas dan pekerjaan dengan mengelolah informasi ini bahkan telah berkembang di berbagai bidang [2]. Di tengah kebutuhan akan pasokan darah yang konsisten dan aman untuk pasien yang membutuhkan, Palang Merah Indonesia (PMI) Kota Batam memiliki peran penting dalam mengoordinasikan proses donor darah. Dalam upaya meningkatkan efisiensi dan aksesibilitas dalam mengelola proses donor darah, pengembangan aplikasi teknologi menjadi suatu solusi yang menjanjikan. Penelitian ini bertujuan untuk mengembangkan aplikasi Donor Darah PMI Kota Batam dengan menggunakan pendekatan metodologi Waterfall.

Penyediaan darah yang cukup dan aman merupakan hal krusial dalam dunia medis. PMI Kota Batam berperan dalam mengoordinasikan kegiatan donor darah untuk memenuhi kebutuhan pasien. Namun, dalam pengelolaan proses donor darah masih terdapat beberapa kendala seperti kurangnya efisiensi dalam koordinasi, informasi yang sulit diakses, serta

keterbatasan dalam mendekatkan kegiatan donor darah kepada masyarakat. Dengan mengoptimalkan pemanfaatan teknologi informasi berupa sistem informasi merupakan pilihan yang tepat karena sistem informasi adalah suatu sistem yang mempunyai kemampuan untuk mengumpulkan informasi dari semua sumber dan menggunakan berbagai media untuk menampilkan informasi [3] [4].

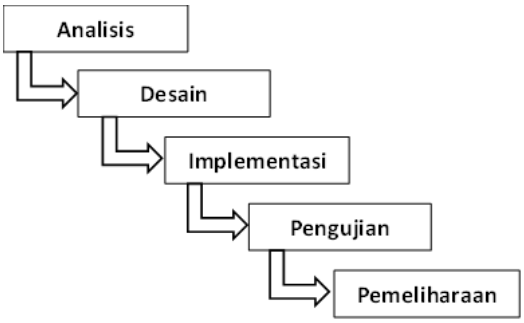
Tujuan dari penelitian ini adalah untuk mengembangkan aplikasi Donor Darah PMI Kota Batam yang dapat meningkatkan efisiensi dalam pengelolaan proses donor darah, mempermudah akses informasi terkait kegiatan donor darah, dan mendekatkan kegiatan donor darah kepada masyarakat.

Hasil penelitian ini diharapkan dapat memberikan manfaat dalam beberapa aspek. Pertama, aplikasi Donor Darah PMI Kota Batam diharapkan dapat mempermudah proses koordinasi dan pengelolaan donor darah, mengurangi kesalahan dalam pencatatan, dan meningkatkan efisiensi waktu. Kedua, aplikasi ini juga diharapkan dapat memberikan akses yang lebih mudah bagi masyarakat untuk mendapatkan informasi terkait kegiatan donor darah, lokasi tempat donor darah, serta jadwal pelaksanaan. Ketiga, aplikasi ini diharapkan dapat menjadi sarana pendekatan antara PMI dan masyarakat, meningkatkan partisipasi dalam kegiatan donor darah, dan pada akhirnya, berkontribusi dalam penyediaan pasokan darah yang memadai.

Penelitian ini memiliki beberapa batasan, antara lain fokus pada pengembangan aplikasi Donor Darah PMI Kota Batam saja, tidak mencakup aspek pengelolaan darah di wilayah lain. Selain itu, penelitian ini tidak membahas aspek teknis dalam pengembangan aplikasi secara mendalam, melainkan lebih berfokus pada pendekatan metodologi Waterfall dan manfaat yang diharapkan dari aplikasi yang dikembangkan.

METODE PENELITIAN

Penelitian ini menggunakan pendekatan metodologi Waterfall, yang terdiri dari beberapa tahapan, yaitu analisis kebutuhan, perancangan sistem, implementasi, pengujian, dan pemeliharaan [5]. Metode ini dipilih karena dapat memberikan kerangka kerja yang terstruktur dan jelas dalam pengembangan aplikasi. Secara umum ada 5 tahapan pada metode Waterfall seperti pada Gambar 1.

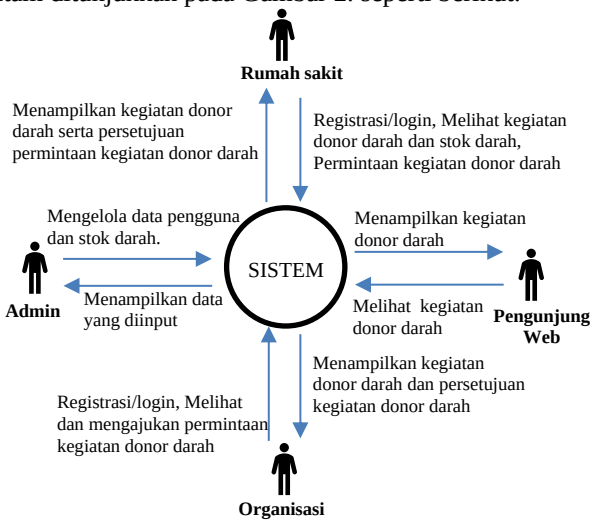


Gambar 1. Diagram Waterfall [4]

Dimana tahapan yang dilakukan pada penelitian ini meliputi berikut:

1. Analisa Kebutuhan
   Kebutuhan terkait aplikasi ini didapatkan dari proses pencarian informasi kepada pihak PMI Kota Batam. Pencarian kebutuhan dilakukan melalui proses wawancara kepada pihak terkait dan didapatkan ebrbagai informasi berupa permasalahan yang terjadi, kebutuhan *system*, serta fitur yang akan dimasukkan pada aplikasi.
2. Desain
   Setelah melakukan identifikasi kebutuhan selanjutnya kami melakukan perancangan aplikasi, menentukan kebutuhan fungsional dan non fungsional, dilanjutkan dengan membuat rancangan antar muka, dan menentukan metode serta langkah uji coba yang nantinya akan diterapkan.
3. Implementasi
   Proses ini dilakukan dengan melakukan pembuatan *website* menggunakan *framework* Laravel, dan *database* menggunakan MySql.
4. Integrasi dan Pengujian Sistem
   Setelah *system* dibuat, tahapan selanjutnya yang dilakukan ada proses pengujian. Pengujian dilakukan menggunakan metode *blackbox testing*. Dimana item yang diuji adalah fungsionalitas dari aplikasi untuk memastikan aplikasi sudah berjalan sesuai rancangan awal. Pengujian dilakukan sesuai dengan *use case scenario* yang sudah disusun pada tahap desain.
5. Pemeliharaan
   Pemeliharaan dilakukan secara berkala ketika aplikasi sudah diterapkan pada PMI Kota Batam. Pemeliharaan meliputi pemeliharaan *website* dan *database*. Memeriksa kemungkinan *error* yang terjadi dan keamanan datanya.

Gambaran umum dari Sistem Informasi Kegiatan Donor Darah Berbasis *Web* Pada PMI Kota Batam ditunjukkan pada Gambar 2. seperti berikut:



Gambar 2. Gambaran Umum Sistem

Dimana informasi dari gambaran umum aplikasinya yaitu:

1. Terdapat empat pengguna yaitu Admin PMI, Rumah Sakit, Organisasi dan Pengunjung *Web* biasa.
2. Admin yaitu pihak PMI merupakan *Super User* yang memberikan keputusan dan menerima data yang masuk kedalam sistem. Admin juga dapat mengelola semua data yaitu membuat, melihat, memodifikasi serta menghapus data pengguna atau yang disebut dengan *Create, Read, Update, and Delete* (CRUD), kegiatan donor darah dan stok darah.
3. Rumah sakit yaitu admin perwakilan dari Rumah Sakit merupakan pengguna yang dapat mengajukan permintaan kegiatan donor darah, melihat stok darah serta mengajukan permintaan stok darah dengan terlebih dahulu mendaftar sebagai pengguna.
4. Organisasi/Instansi terdiri dari universitas, organisasi lokal, sekolah maupun perusahan terbatas dan lain-lain selain pihak PMI dan Rumah Sakit. Pengguna ini dapat mengajukan permintaan kegiatan donor darah denga terlebih dahulu mendaftar sebagai pengguna.
5. Admin menerima data yang diinput dari sistem oleh pengguna dan mengkonfirmasi keputusan terhadap data tersebut.
6. Selain tiga pengguna diatas, Sistem Informasi Kegiatan Donor Darah ini dapat diakses pengunjung biasa tanpa harus registrasi atau *login* untuk mendapatkan jadwal kegiatan donor darah.

Selain itu, aplikasi ini memiliki beberapa kebutuhan fungsional seperti yang ditunjukkan pada Tabel 1. yang nantinya juga akan menjadi acuan untuk melakukan pengujian aplikasi menggunakan metode *blackbox testing*.

Tabel 1. Kebutuhan Fungsional

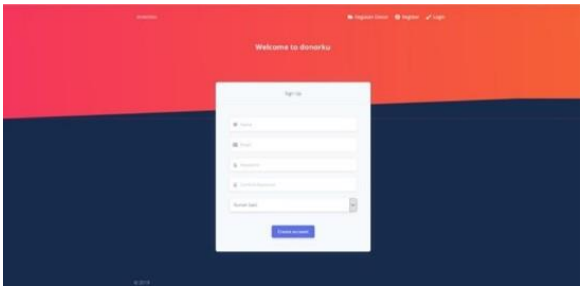
No	Kode	Kebutuhan Fungsional
1	F-01	Sistem mampu registrasi
2	F-02	Sistem mampu *login*
3	F-03	Sistem mampu menambah data pengguna
4	F-04	Sistem mampu mencari data pengguna
5	F-05	Sistem mampu mengubah data pengguna
6	F-06	Sistem mampu menghapus data pengguna
7	F-07	Sistem mampu menambah data kegiatan donor darah
8	F-08	Sistem mampu mencari data kegiatan donor darah
9	F-09	Sistem mampu mengubah data kegiatan donor darah
10	F-10	Sistem mampu menghapus data kegiatan donor darah
11	F-11	Sistem mampu menambah data stok darah
12	F-12	Sistem mampu mencari data stok darah
13	F-13	Sistem mampu mengubah data stok darah
14	F-14	Sistem mampu menerima data permintaan kegiatan donor darah
15	F-15	Sistem mampu memproses permintaan kegiatan donor darah
16	F-16	Sistem mampu menerima data permintaan stok darah
17	F-17	Sistem mampu memproses permintaan stok darah
18	F-18	Sistem mampu menambah koordinat lokasi pada map
19	F-19	Sistem mampu mencetak laporan riwayat aktivitas pengguna

HASIL DAN PEMBAHASAN

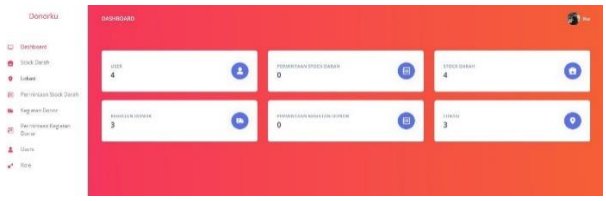
Tahapan selanjutnya yaitu implemtasi dan pembuatan aplikasi menggunakan *framework* Laravel. Produk aplikasi yang dihasilkan memiliki beberapa halaman dan dijelaskan sebagai berikut. Halaman pertama yang dapat diakses oleh pengguna adalah halaman *register* yang diperlihatkan pada Gambar 3. Dimana pada halaman ini pengguna melakukan registrasi ke sistem. Pengguna diharuskan mengisi *form* yang ada dengan tepat dan sesuai. Setelah registrasi, pengguna akan melanjutkan ke halaman *login*. Untuk mengakses sistem dibutuhkan proses *login* dengan mengisi *form* yang ada. Setelah proses *login* berhasil, pengguna akan masuk ke halaman *home* yang ditampilkan pada Gambar 4. Setelah *login*, pengguna berada dihalaman *home* yang terdiri dari beberapa *menu* yang ditunjukkan pada Tabel 2.

Tabel 2. Menu Aplikasi

No	Menu	Fungsi
1	*Dashboard*	Berfungsi sebagai catatatn yang menunjukkan riwayat pengguna
2	Stok Darah	Untuk mengelola persediaan stok darah
3	Lokasi	Digunakan untuk menambah data lokasi untuk input data lokasi pada kegiatan donor darah
4	Permintaan Stok Darah	Untuk mengelola permintaan stok darah
5	Kegiatan Donor	Untuk mengelola kegiatan donor darah
6	Permintaan Kegiatan Donor	Digunakan untuk mengelola permintaan kegiatan donor
7	*Users*	Untuk mengelola data pengguna
8	*Role*	Untuk riwayat *role* pengguna



Gambar 3. Halaman Registrasi



Gambar 4. Halaman *Home*

Pengujian aplikasi ini menggunakan metode *blackbox testing* yang ditunjukkan pada Tabel 3. Dimana pengujian dilakukan oleh tim pengembang aplikasi dan pengguna dari Palang Merah Indonesia kota Batam.

Tabel 3. Pengujian Aplikasi

No	Proses	Skenario	Target	Hasil
1	Registrasi	Memasukkan data pada *form* yang sesuai	*Register* berhasil dan masuk ke Halaman *home*	Berhasil
		Memasukkan data pada *form* tidak sesuai	*Register* gagal dan tetap berada pada *form register*	Berhasil
		Memasukkan data pada *form* kosong	Register gagal dan tetap berada pada *form register*	Berhasil
2	*Login*	Memasukkan *username* dan *password* yang sesuai	*Login* berhasil dan masuk ke halaman *home*	Berhasil
		Memasukkan *username* dan *password* tidak sesuai	*Login* gagal dan tetap berada di halaman *login*	Berhasil
		Memasukkan *username* dan *password* kosong	*Login* gagal dan tetap berada di halaman *login*	Berhasil
3	Menambah Data Pengguna	*User* memilih menu tambah data pengguna	*User* berhasil masuk ke halaman tambah data pengguna	Berhasil
		User memasukkan data pada *form* pengguna	Data berhasil dimasukkan	Berhasil
4	Mencari Data Pengguna	*User* memilih menu pengguna	*User* berhasil masuk ke halaman pengguna	Berhasil
		User memasukkan data pencarian dikolom pencarian	Data berhasil dicari	Berhasil
5	Mengubah Data Pengguna	*User* memilih menu *edit* data pengguna	*User* berhasil masuk ke halaman *edit* data pengguna	Berhasil
		User memasukkan data pada *form* pengguna	Data berhasil diubah	Berhasil
6	Menghapus Data Pengguna	*User* memilih "ya" hapus data pengguna	Data berhasil dihapus	Berhasil
		User memilih "tidak" hapus data pengguna	Data tidak dihapus	Berhasil
7	Menambah Data Kegiatan Donor Darah	*User* memilih menu tambah kegiatan donor darah	*User* berhasil masuk ke halaman tambah data kegiatan donor darah	Berhasil
		User memasukkan data pada *form* kegiatan	Data berhasil dimasukkan	Berhasil
8	Mencari Data Kegiatan Donor Darah	*User* memilih menu pengguna	*User* berhasil masuk ke halaman pengguna	Berhasil
		User memasukkan data pencarian dikolom pencarian	Data berhasil dicari	Berhasil
9	Mengubah Data Kegiatan Donor Darah	*User* memilih menu *edit* kegiatan	*User* berhasil masuk ke halaman *edit* data kegiatan	Berhasil
		User memasukkan data pada *form*	Data berhasil diubah	Berhasil

No	Proses	Skenario	Target	Hasil
		kegiatan		
10	Menghapus Data Kegiatan Donor Darah	*User* memilih "ya" hapus kegiatan	Data berhasil dihapus	Berhasil
		User memilih "tidak" hapus kegiatan	Data tidak dihapus	Berhasil
11	Menambah Data Stok Darah	*User* memilih menu tambah stok darah	*User* berhasil masuk ke halaman tambah data stok darah	Berhasil
		User memasukkan data pada form stok darah	Data berhasil dimasukkan	Berhasil
12	Mencari Data Stok Darah	*User* memilih menu stok darah	*User* berhasil masuk ke halaman stok Darah	Berhasil
		User memasukkan data pencarian dikolom pencarian	Data berhasil dicari	Berhasil
13	Mengubah Data Stok Darah	*User* memilih menu *edit* stok darah	*User* berhasil masuk ke halaman *edit* stok darah	Berhasil
		User memasukkan data pada form jumlah stok darah	Data berhasil diubah	Berhasil
14	Menerima Pengajuan Permintaan Donor Darah	*User* memilih menu permintaan kegiatan donor	*User* berhasil masuk ke halaman permintaan kegiatan donor	Berhasil
15	Memproses Permintaan Kegiatan Donor Darah	Admin memilih menu permintaan kegiatan donor	Admin berhasil memproses permintaan kegiatan donor	Berhasil
16	Menerima Pengajuan Permintaan Stok Darah	*User* memilih menu permintaan stok darah	*User* berhasil masuk ke halaman permintaan stok darah	Berhasil
17	Memproses Permintaan Stok Darah	Admin memilih menu permintaan stok donor	Admin berhasil memproses permintaan stok darah	Berhasil
18	Menambah Koordinat Lokasi	*User* memilih menu lokasi	*User* berhasil masuk ke halaman lokasi	Berhasil
		User memasukan nama lokasi	Lokasi yang ditambahkan berhasil masuk, koordinat berhasil didapat	Berhasil
19	Mencetak Laporan Riwayat Aktifitas Pengguna	*User* memilih menu *generate pdf*	*User* berhasil mencetak laporan	Berhasil

Dari hasil pengujian pada Tabel 3. dapat diketahui bahwa semua kebutuhan fungsional berhasil untuk dilakukan sesuai dengan *scenario* yang telah dibuat.

Setelah aplikasi diuji secara fungsional, selanjutnya dilakukan pengujian aplikasi terhadap calon pengguna dengan menggunakan metode *System Usability Scale* (SUS) yang merupakan kuesioner yang dapat digunakan untuk mengukur *usability* sistem komputer menurut sudut pandang subyektif pengguna dengan mencoba aplikasi ke calon pengguna, dimana sampel yang dipilih adalah masyarakat kota Batam yang pernah melakukan donor darah. Peneliti menjelaskan ke target uji mengenai aplikasi ini, bagaimana cara menggunakannya dan mempersilahkan mereka untuk mencoba. Setelah itu target uji diberikan kuisioner dan meminta bagaimana pendapat mengenai aplikasi cerita rakyat interaktif ini. Total terdapat 10 pertanyaan yang ditanyakan kepada 30 pasang responden. Daftar pertanyaan pengujian ditunjukkan pada Tabel 4.

Tabel 4. Daftar Pertanyaan Pengujian

Kode	Pernyataan
R1	Saya pikir bahwa saya ingin lebih sering menggunakan aplikasi ini
R2	Saya menemukan bahwa aplikasi ini, tidak harus dibuat serumit ini
R3	Saya pikir aplikasi mudah untuk digunakan
R4	Saya pikir bahwa saya akan membutuhkan bantuan dari orang teknis untuk dapat menggunakan aplikasi ini
R5	Saya menemukan berbagai fungsi di aplikasi ini diintegrasikan dengan baik
R6	Saya pikir ada terlalu banyak ketidaksesuaian dalam aplikasi ini

R7	Saya bayangkan bahwa kebanyakan orang akan mudah untuk mempelajari aplikasi ini dengan sangat cepat
R8	Saya menemukan, aplikasi ini sangat rumit untuk digunakan
R9	Saya merasa sangat percaya diri untuk menggunakan aplikasi ini
R10	Saya perlu belajar banyak hal sebelum saya bisa memulai menggunakan aplikasi

Dari kuesioner SUS yang didistribusikan, responden diharuskan untuk mengisi kolom penilaian dari setiap *item* pertanyaan sesuai dengan apa yang dirasakan saat melakukan percobaan menggunakan sistem. Selanjutnya hasil dari kuesioner yang telah diisi oleh responden direkapitulasi dan dilakukan perhitungan pada setiap jawaban dengan ketentuan sebagai berikut:

a. Setiap pertanyaan bernomor ganjil, skor setiap pertanyaan yang didapat dari skor pengguna akan dikurangi 1.
b. Setiap pertanyaan bernomor genap, skor akhir didapat dari nilai 5 dikurangi skor pertanyaan yang didapat dari pengguna.
c. Skor SUS didapat dari hasil penjumlahan skor setiap pertanyaan yang kemudian dikali 2,5.

Dari hasil rekapitulasi skor SUS didapatkan skor rata-rata yang kemudian akan kita Tarik kesimpulannya. Tahap selanjutnya adalah menentukan hasil penilaian SUS. Untuk menentukan hasil penilaian SUS digunakan *Net Promoter Score* (NPS).

NPS merupakan metode yang efektif untuk mengontrol serta mengukur tingkat kepuasan pengguna. Terdapat beberapa pola yang berbeda serta respon yang berbeda pada setiap kelompok pegguna, yaitu: 1. *Promoter* - bagi orang yang merespon dengan memberi nilai 77,2-100 biasanya digambarkan dengan melakukan penggunaan secara berulang; 2. Pasif - orang-orang yang memberikan produk atau aplikasi skor 62,7-77,1; dan 3. *Detractor* (pencela) - yang memberikan *score* 0-62,6. Skor mereka menunjukkan bahwa respon pengguna berkurang atau produk atau aplikasi yang digunakan.

Perhitungan skor SUS pada penelitian ini dapat dilihat pada Tabel 5. dan didapat rata-rata skor akhir SUS dari responden sebesar 70,00.

Tabel 5. Hasil Pengujian Usabilitas

Skor SUS	*Adjective*	*Grade Scale*	*Acceptability*	NPS
70,00	*Good*	B	*Yes*	*Passive*

Dari hasil skala penentuan hasil penilaian SUS dapat dijelaskan secara detail ke dalam skala skor SUS sebagai berikut:

1) Skor SUS yang diperoleh pada penelitian ini 70,00 yang didapat dari pengguna, jika dikorelasikan dengan skala *grade* aplikasi berada pada *grade* B yang menunjukkan skor tersebut cukup baik. Dan aplikasi yang dikembangkan bisa diterima oleh pengguna.
2) *Acceptability*. Variasi lain dalam menggambarkan SUS adalah melalui pernyataan yang dapat diterima atau tidak dapat diterima. Skor SUS sebesar 70,00 mengindikasikan aplikasi ini dapat diterima namun masih butuh peningkatan.
3) NPS. Skor SUS sebesar 70,00 mengindikasikan aplikasi yang dikembangkan ini ada pada kategori pasif.

Untuk selanjutnya aplikasi ini akan dilakukan proses *hosting* dan perawatan aplikasi. Dimana tahapan ini akan dilakukan oleh tim pengembang dan pihak admin yang telah ditentukan oleh pengguna. Perawatan meliputi pengecekan terkait *bug* pada aplikasi, memastikan tidak ada *error* ketika aplikasi dijalankan dan memastikan data pengguna aman dan tidak disalahgunakan.

KESIMPULAN

Aplikasi donor darah ini dikembangkan untuk membantu pihak Palang Merah Indonesia Kota Batam dan Masyarakat Kota Batam sebagai penggunanya agar lebih mudah untuk mencari informasi terkait kegiatan donor darah. Aplikasi dikembangkan dengan menggunakan metode Waterfall dan diberikan beberapa fitur yang dibutuhkan oleh pengguna. Aplikasi yang dibuat dalam bentuk *website* ini diuji dengan menggunakan metode *blackbox testing* sesuai dengan *scenario* pengujian. Hasilnya semua fungsionalitas aplikasi ini dapat berjalan dengan baik. Kemudian dilakukan pengujian aplikasi terhadap calon pengguna dengan menggunakan metode *System Usability Scale* (SUS) yang merupakan kuesioner yang dapat digunakan untuk mengukur *usability* sistem komputer menurut sudut pandang subyektif pengguna. Perhitungan skor SUS pada penelitian ini didapat rata-rata skor akhir SUS dari responden sebesar 70,00 dimana jika dikorelasikan dengan skala *grade* aplikasi berada pada *grade* B yang menunjukkan skor tersebut cukup baik. Aplikasi yang dikembangkan bisa diterima oleh pengguna tetapi masih membutuhkan peningkatan. Untuk kedapnnya aplikasi akan dikembangkan sesuai dengan peningkatan kebutuhan pengguna seperti adanya pengguna individu atau pendonor yang dapat *login* sebagai *user* dan memberikan informasi terkait kartu anggota donor darah.

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Indonesian Sign Language (SIBI) Learning Media Application Based on Deep Learning Technology for Deaf Children

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Abstract: *One of the main methods in teaching deaf children effectively is through visualization of learning materials. Previous research has developed augmented reality-based interactive learning media for deaf children. However, these learning media have limitations related to smartphone memory, dependence on certain flashcards, and limited amount of material due to flashcard limitations. Here, researchers innovate to develop SIBI learning media applications based on deep learning technology that material does not depend on a specific flashcard, but the application is able to detect real objects and various images. TensorFlow Lite is considered lighter but still allows the system to run deep learning on mobile devices with low latency. This application is designed to capture a real object or image through the camera, then the object or image will be processed and recognized using TensorFlow Lite. The object recognition process is carried out at the classification layer using switch-case syntax and global class synchronization with the YouTube API. After the image or object is recognized, the system will issue an output in the form of an Indonesian sign language video link from the object.*

Keywords*: Deaf Children; Deep Learning; Image Recognition; Indonesian Sign Language (SIBI); Learning Media Application*

INTRODUCTION

Indonesian survey data [1] shows that 7,87% of people suffer from hearing disorder. While 2,74% of people have speech and hearing disorders. As many as 1,307,094 hearing disorder people live in the province of East Java. Based on- field study at TKLB Karya Mulia Surabaya, learning media used for the teaching and learning process to hearing-impaired children using original objects, imitation objects, and images through flashcards. Even though [2], shows one of the key methods of teaching hearing-impaired children is through visualization of learning materials. Then the presentation of learning materials using technology and ICT is vital to support the teaching and learning process both during class activity and in the self-study process. Especially during the pandemic covid-19, direct meeting class activities are limited, so students are required to study independently.

The limited sense of hearing encourages hearing-impaired children to adapt by using other ways to communicate, such as using sign language. Which one of the National Sign Language standards in Indonesia is using the Indonesian Sign Language or SIBI [2]. The process of understanding sign language and mastering vocabulary for children with hearing impairment is the earlier the better. In this case, the role of parents is very influential for hearing-impaired children. Therefore, appropriate learning media are needed to help teachers, parents, and children with hearing-impaired to improve their communication learning skills from early stage.

Hearing-impaired children would learn more effectively through a learning system that is supported by as many visual displays as possible. The use of technology makes a major contribution to improving the quality of education in deaf schools [6]-[8]. The importance of technology in learning media for individuals with hearing loss was also investigated [9]. The results show that it is highly recommended that a mobile application based on the Android and iOS operating systems be developed as a learning medium for hearing-impaired children.

Quite a number of learning media technologies for deaf children have been developed, such as [10] who developed AR as a learning medium for deaf children in Arabic sign language. Meanwhile, researchers here have also developed AR as a learning medium for deaf children in Indonesian sign language (SIBI) [4] and [5]. The digital learning media is used by teachers and students in TKLB Karya Mulia Surabaya until now. However, these learning media have limitations tied to smartphone memory, dependence on certain flashcards, and the limited amount of material due to flashcard limitations.

Here researchers are innovating to develop SIBI learning media application based on deep learning technology for hearing-impaired children. The materials don't depend on certain flashcards, but the application would detect various real objects and images. That way, learning materials would be sustainably added and developed. We hope to give benefit and contribute for hearing-impaired children through the development of this application.

METHOD

In this study, learning media was developed based on deep learning so that learning materials were not limited and depended on the availability of flashcards. Deep learning systems teach computers to do the work humans are supposed to do, just as computers can learn from the training process. Deep learning uses a problem-solving approach in a computer learning system that uses the concept of a hierarchy. The concept of

hierarchy allows computers to learn complex concepts by combining simpler concepts. The architecture used consists of a visible layer and a hidden layer where the load of each perceptron unit is optimized using the backpropagation algorithm. In this research, we use TensorFlow Lite as a solution for best implementing deep learning to mobile devices. TensorFlow Lite is considered lighter but still allows the system to run machine learned models on mobile devices with low latency. Figure 1 is an overview of the design of the learning media application system that was built in this study. The application system requires a user interface design so that users are interested and easy to use. This application is designed to capture an object or image through the camera, then the object or image will be processed and recognized using TensorFlow Lite. This object recognition has been assigned to the classification layer. After the image or object is recognized, the system will issue an output in the form of a sign language video link from the object. All sign language videos are stored on YouTube cloud storage.

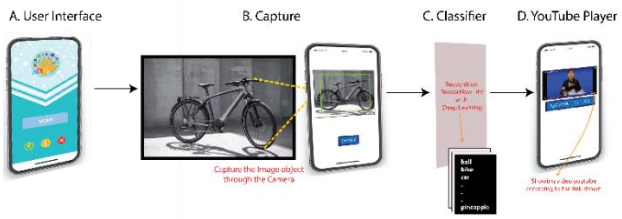
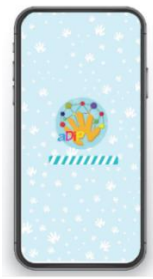


Figure 1. Application System Design

In the development of this application, we have set the appropriate color and text type for children aged 4-6 years which is the age range of deaf kindergarten children in Indonesia. The mockup design for the application consists of five parts, as follows: splash screen, home screen, instructions screen, information screen, and camera screen as shown in Table 1.

Table 1. Mockup Design

	**Splash Screen** The initial appearance when the android application is opened/run for the first time, its function is to make the application more attractive and professional.
	**Home Screen** The ADIP (Deep Learning Application) logo will appear on the home screen. There are five buttons that appear as vocabulary, wording, instructions, information and exit buttons, where each button is connected to another screen.
	**Instruction Screen** This screen displays instructions for using the application. This screen is equipped with an exit button to return to home screen.
	**Information Screen** This screen displays information regarding the application. This screen is equipped with an exit button to return to home screen.
	**Camera Screen** On this screen, users can scan images or objects to be studied sign language. The scanned image or object will be processed by the system. The system will provide output in the form of a link that leads to a sign language demonstration video of the image or object.

The working system of this application is presented in the flowchart in Figure 2. First, the user is asked to scan an image or object that he wants to recognize, using a smartphone camera; then the system will process the image or object via TensorFlow Lite; the system will provide output in the form of a sign language demonstration video link from the image or object so that users could watch it.

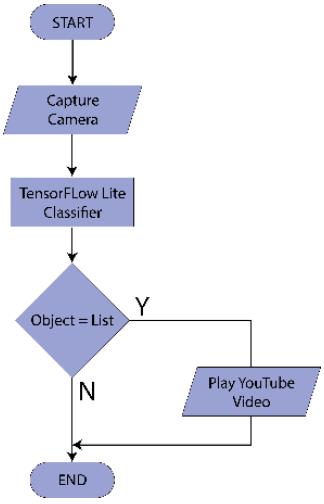


Figure 2. Flowchart System

In the classifier section, there is a recognition section which object classification using switch-case syntax, and global class synchronization with the YouTube API. Here we don't carry out the manual recognition of the asset input stage but uses existing assets from TensorFlow lite. The type of model used is mobilenet_quant_v1_224.tflite, with the number of label names originating from the TensorFlow Lite is 1001 words. However, with that many labels, it is not necessarily used entirely, since the output of this application is a video display of SIBI taken from previous research. The application would distinguish which one should be used or not. The application requires a class to classify objects then given the Switch and Case statements. The switch-case statement will execute the program if the value in the switch statement is the same as the value in the case statement. It makes easier for the system to display a video link to display the SIBI display results from recognizing objects and captured images. There are 14 Indonesian sign language demonstration videos that have been synchronized with Tensorflow Lite in this study. The addition of recognizable objects is very possible, by adding the number of Indonesian sign language demonstration videos in the next development as shown in Table 2.

There are several daily objects that are selected as SIBI objects. The selection of these objects refers to the TKLB Karya Mulia curriculum and is based on the results of consultations with teachers. These objects are included in the application program. In practice, if the application scans one of the objects, the application would display the SIBI video for learning Indonesia Sign vocabulary for deaf children.

Table 2. The Recognizable Objects for SIBI

Bus	Ship
Bike	Plane
Motorcycle	Shoes
Wall Clock	Hat
Clothes	Ball
Table	Bag
Chairs	Pineapple

RESULT AND DISCUSSION

There are four types of application testing that have been carried out in this study. They are functionality testing, objects testing, device testing, and user testing. The application testing process could be seen in Figure 3. The test results are discussed in the following sub-sections:

Figure 3. Image Recognition Experiments with Wall Clock as SIBI Object

Functionality Testing

Functionality testing aims to determine the functionality of each button on each application screen. There are seven types of buttons tested from six screens as follows:

- Scan button
- Hint button
- Information button
- Link code button
- Video playback button
- Exit button
- Decision (Yes/No) button

The main device that supports this test is an Android smartphone that has specifications as shown in Table 3. The functionality testing result can be seen in Table 4. The test results show that each button on every screen is running according to its function properly.

Table 3. Specification Device

Description	Specification
Device	Vivo Y12
Android version	Android 9 (Pie)
CPU	Mediatek MT6762 Helio P22 (12 nm) Octa-core Cortex-A53
RAM/ROM	3/32 GB
GPU	PowerVR GE8320
Screen Resolution	720x1544 px

Table 4. Result of Functionality Testing

User Interface	Testing Materials	Expected results	Test Result
Home Screen 	Button scan	Open to the camera screen	Valid
	Hint button	Open to the instructions page	Valid
	Information button	Open to the information page	Valid
	Exit button	Pop-up decision question box appears	Valid
Instruction Screen 	Exit button	Return to the home screen	Valid
Information Screen 	Exit button	Return to the home screen	Valid
Camera Screen 	Link code button	Open to the YouTube Player Screen	Valid
Youtube media player 	Video playback button	Playback the video	Valid
Decision Box 	Decision (Yes / No) button	If pressing "Yes" button would bring out and close the application. If pressing "No" button would return to the home screen	Valid Valid

Objects Testing

We tested the performance of the application with 14 different types of objects in-order-to determine the success rate of the application in recognizing objects and displaying Indonesian sign language demonstration videos correctly. The test results show the application could recognize all objects and display videos correctly as shown in Table 5.

Table 5. Result of SIBI Objects Testing

Objects	Link Code	Test Result
Bus	HwZcAsPMhmI	Valid
Bike	ifwVdog6zSo"	Valid
Motorcycle	HTJrmnkisk0	Valid
Wall Clock	HuT6Tn_pDBk	Valid
Clothes	uBdc16NJ6B0	Valid
Table	l1k_SLknkFw	Valid
Chair	SMute7FUqOA	Valid
Ship	A7EzNeQFd-A	Valid
Plane	PLrQVND_s_A	Valid
Shoes	ifwVdog6zSo	Valid
Hat	TOLZG-Yh2vs	Valid
Ball	DPsE_TZ3Pig	Valid
Bag	4jUj4CKcZfg	Valid
Pineapple	rHp0veex_3g	Valid

Devices Testing

Device testing aims to find out the recommended device specifications for this application, including the minimum device specifications required for the application to run properly. There are five types of devices tested in this study; they have specifications as listed in Table 6.

The device test results are listed in table VII, showing that device specifications also affect application performance. Device numbers 1,2,3, and 4 require an average processing time of less than 10 seconds. We recommend this app run on android device version 8 or above. Referring to the device testing that has been carried out on Android version 5, the application failed to recognize objects so that it could not display videos on the YouTube media player. The application also has an error when trying to exit the application as seen in Table VII.

Table 6. Specification Various Device

No.	Device	Android version	CPU	RAM/ ROM	Screen Resolution
1	Samsung A70	10	Octa-core (2x2.0 GHz Kryo 460 Gold & 6x1.7 GHz Kryo 460 Silver)	6/128 GB	2400 x1080 px.
2	Samsung j6+	9	Quad-core 1.4 GHz Cortex-A53	4/64 GB	720 x1480 px
3	Xiaomi redmi 8A	9.0	Octa-core (4x1.95 GHz Cortex-A53 & 4x1.45 GHz Cortex A53)	2GB /32GB	720 x1520 px
4	Oppo A5S	8.1.0	Eight Core	3/32 GB	720x1520px
5	Oppo Mirror 5	5.1.1	Quad-core 1.2 GHz Cortex-A53	2/16 GB	540x960 px

Table 7. Result of Device Testing

1. Samsung A70

	Trial-1 (second)	Trial-2 (second)	Trial-3 (second)	Average(second)
Installation	8,45			
Loading to open the application	9,16	8,67	8,51	8,78
Home screen	2,16	1,12	0,40	1,7
The appearance of the link code button	2,05	1,82	1,93	4,51
The appearance of the youtube media player	2,06	1,20	1,12	1,46
Information Screen	1,50	0,48	0,16	0,73
Instruction Screen	1,60	0.40	1	1
Decision (Yes/No) box	2	0,56	0,41	0,99

2. Samsung j6+

	Trial-1 (second)	Trial-2 (second)	Trial-3 (second)	Average (second)
Installation	5			
Loading to open the application	9	3	2	4.6
Home screen	8	8	7	7,7
The appearance of the link code button	7	5	5	5,7
The appearance of the youtube media player	8	4	4	5,3
Information Screen	7	5	2	4,7
Instruction Screen	6	5	2	4,3
Decision (Yes/No) box	4	0	0	1,3

3. Redmi 8A

	Trial-1 (second)	Trial-2 (second)	Trial-3 (second)	Average (second)
Installation	14			

Loading to open the application	11,4	11,01	11,04	11,15
Home screen	1,6	2,76	1,76	2,04
The appearance of the link code button	3,16	2,97	3,40	3,18
The appearance of the youtube media player	1,26	1,14	0,94	1,11
Information Screen	0,75	0,6	0,56	0,64
Instruction Screen	0,73	0,8	0,66	0,73
Decision (Yes/No) box	1,64	2,38	1,88	1,97

4. Oppo A5S

	Trial-1 (second)	Trial-2 (second)	Trial-3 (second)	Average (second)
Installation	8,05			
Loading to open the application	6,22	1,31	9,22	5,58
Home screen	2,42	1,71	2,04	2,06
The appearance of the link code button	2,56	1,71	2,36	2,21
The appearance of the YouTube media player	-	14,90	4,13	6,34
Information Screen	2,23	0,73	0,73	1,23
Instruction Screen	1,71	0,73	0,73	1,05
Decision (Yes/No) box	3,15	1,19	1,19	1,84

5. Oppo Mirror5

	Trial-1 (second)	Trial-2 (second)	Trial-3 (second)	Average (second)
Installation	8,05	8,05		
Loading to open the application	11,35	10,14	9,99	10,4
Home screen	4,33	3,28	3,47	3,69
The appearance of the link code button	0,5	0,5	0,5	0,5
The appearance of the YouTube media player	Return to the splash screen page	Return to the splash screen page	Return to the splash screen page	-
Information Screen	-	-	-	-
Instruction Screen	-	-	-	-
Decision (Yes/No) box	error	error	error	error

User Testing

User testing in this study used in-depth interviews method with users. We tested two users, each of whom had a different scientific background. The first is a teacher of deaf children at the Karya Mulia TKLB school in Surabaya, the second is a software developer. Users are asked to try using the application and all its features. Then we interviewed them to explore their experience of using the application and asked for their opinion according to their scientific field. User test results are summarized in table VIII, in which each aspect is rated using the Likert's scale (5 = excellent, 4 = good, 3 = fair, 2 = poor, and 1 = very poor, need improvement).

Table 8. Result of User Testing

Testing Materials	1st User	2nd User
Easy usage and navigation	4	3
The app running properly	3	3
Precise functionality of the buttons	5	5
Clear text and match color for kids	5	5
Appropriate language use	4	4
User satisfaction	3	4
Benefits of using the app	4	4

From the results of the expert assessment, it would be concluded that the application can run well, all buttons and features function properly. Users also feel that the selection of color and text themes is appropriate for children aged 4-6 years who are the targeted of the application. The 1st user is welcoming the presence of this learning media application for deaf children, she requests this application be developed by adding the

number of Indonesia sign language demonstration videos provided in the database to enrich learning materials. The 2nd user provide suggestion for application development, should add additional pop-up contained of instruction usage method on the camera screen.

CONCLUSION AND SUGGESTION

Based on the test results, it is concluded Indonesian sign language learning media applications based on deep learning could running properly. It's proven from button functional test and objects test result are 100% succeed. The results of user testing also show satisfaction and a good response to the presence of this application. The addition of the Indonesian sign language demonstration video in the database is expected to enrich the learning material. In practice, this learning media is recommended to run on Android version 8 or more. In the future, the application can be equipped with hundreds or thousands of objects connected to the SIBI video display so that a digital SIBI dictionary can be realized for Indonesian deaf children.

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Pengenalan Ekspresi Wajah Secara *Real-Time* Menggunakan Metode SSD *Mobilenet* Berbasis Android

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Abstrak: Pengenalan ekspresi wajah secara *real-time* menjadi topik yang menarik dalam bidang pengolahan citra dan kecerdasan buatan. Penelitian ini bertujuan untuk mengembangkan sebuah metode yang dapat mendeteksi objek ekspresi wajah secara akurat dan efisien. Untuk mencapai tujuan ini, peneliti mengadopsi pendekatan berbasis *Single Shot MultiBox Detector* (SSD) yang terkenal dalam deteksi objek. Peneliti melatih model SSD menggunakan *dataset* wajah dengan berbagai ekspresi. Metode yang diusulkan memanfaatkan fitur-fitur wajah yang penting untuk memperoleh lokalisasi dan klasifikasi ekspresi wajah. Peneliti melakukan pelatihan menggunakan algoritma pembelajaran mendalam dengan menggunakan data wajah yang dikategorikan berdasarkan ekspresi tertentu. Eksperimen dilakukan pada citra wajah yang diambil secara *real-time*, dan hasil deteksi objek wajah dievaluasi berdasarkan ukuran akurasi dan kecepatan. Hasil penelitian menunjukkan bahwa metode yang diusulkan mampu mendeteksi ekspresi wajah secara *real-time* dengan akurasi tinggi dan kecepatan pemrosesan yang baik. Hasil evaluasi menggunakan *Metric Evaluation,* model memiliki akurasi 0,51 detik dan kecepatan deteksi 31 *frame* per-detik dimana dengan demikian model dapat berjalan dengan komputasi rendah pada erangkat *mobile*. Temuan ini menunjukkan bahwa metode yang diusulkan berpotensi menjadi solusi efektif untuk pengenalan ekspresi wajah secara *real-time* dalam berbagai aplikasi, termasuk pengenalan emosi, interaksi manusia-mesin, dan keamanan.

Kata Kunci: Deteksi Objek; Pengenalan Ekspresi Wajah; SSD

Abstract: *Real-time facial expression recognition has become an intriguing topic in the fields of image processing and artificial intelligence. This study aims to develop a method that can accurately and efficiently detect facial expression objects. To achieve this goal, we adopt the well-known Single Shot MultiBox Detector (SSD) approach in object detection. We train the SSD model using a facial dataset with various expressions. The proposed method utilizes important facial features for localization and classification of facial expressions. We train the model using deep learning algorithms with categorized facial data based on specific expressions. Experiments are conducted on real-time captured facial images, and the results of facial object detection are evaluated based on accuracy and speed metrics. The findings demonstrate that the proposed method is capable of real-time facial expression detection with high accuracy and good processing speed. We achieve satisfactory evaluation results with a detection accuracy of over 0.5 and a detection speed of more than 30 frames per second. These findings suggest that the proposed method holds potential as an effective solution for real-time facial expression recognition in various applications, including emotion recognition, human-machine interaction, and security.*

Keywords: *Facial Expression Recognition; Object Detection; SSD*

PENDAHULUAN

Pengenalan ekspresi wajah secara *real-time* telah menjadi subjek yang menarik dalam bidang pengolahan citra dan kecerdasan buatan sekaligus memiliki berbagai aplikasi potensial dalam pengenalan emosi, interaksi manusia-mesin, dan keamanan[1]. Namun, deteksi objek ekspresi wajah yang akurat dan efisien tetap menjadi tantangan yang signifikan dalam pengembangan sistem ini. Sebagai contoh, pendekatan konvensional yang memerlukan pemrosesan berurutan dan membutuhkan waktu lama tidak memenuhi persyaratan *real-time*. Oleh karena itu, penelitian ini bertujuan untuk mengembangkan sebuah metode yang dapat mendeteksi objek ekspresi wajah secara akurat dan efisien dalam *real-time*. Pendekatan berbasis *Single Shot MultiBox Detector* (SSD) dipilih sebagai dasar penelitian ini. SSD telah terbukti efektif dalam deteksi objek pada berbagai aplikasi[2]. Dalam konteks pengenalan ekspresi wajah, metode ini dapat memperoleh lokalisasi dan klasifikasi ekspresi wajah secara simultan, mengatasi kendala waktu pemrosesan yang lambat. Selain itu, penggunaan fitur-fitur wajah yang penting dalam pengenalan ekspresi wajah, yang menunjukkan bahwa fitur-fitur tersebut dapat menjadi petunjuk penting dalam membedakan ekspresi wajah[3].

SSD merupakan suatu algoritma yang mampu mengidentifikasi objek pada gambar atau video dengan akurasi tinggi dan memproses gambar dari kamera dengan kecepatan yang lebih cepat[4]. Metode SSD menunjukkan tingkat akurasi yang lebih tinggi jika dibandingkan dengan metode sejenis seperti Y*ou Only Look Once* (YOLO) dan *Region based Convolutional Neural Networks* (RCNN) [5]. Metode ini mampu memberikan tingkat akurasi yang lebih akurat

dibandingkan dengan YOLO, serta memiliki kecepatan pemrosesan yang lebih cepat dibandingkan dengan RCNN. Meskipun demikian, metode ini memiliki kelemahan dalam mendeteksi objek dengan ukuran kecil yang masih dirasakan kurang efektif[6].

Beberapa penelitian lain telah menggunakan permasalahan penghitungan objek. Salah satunya adalah penelitian yang berjudul "Perancangan Program Pendeteksi dan Pengklasifikasi Jenis Kendaraan dengan Metode *Convolutional Neural Network* (CNN) *Deep Learning*". Penelitian ini membahas tentang proses deteksi, klasifikasi, dan penghitungan kendaraan menggunakan metode *Convolutional Neural Network* (CNN) *Deep Learning* dengan menggunakan algoritma *You Only Look Once* (YOLO). Namun, hasilnya masih memiliki kekurangan, yaitu akurasi yang belum maksimal saat mendeteksi objek di jalan yang padat[7].

Penentuan atau perbandingan model detektor objek terbaik antara YOLO, SSD, dan Faster-RCNN cukup sulit dalam konteks aplikasi kehidupan nyata. Ada beberapa faktor yang mempengaruhi kinerja ketiga model detektor objek tersebut, termasuk jumlah fitur yang ada, resolusi citra yang digunakan, jumlah *dataset* yang tersedia, dan penggunaan data *augmentation*[8].

Penelitian [9] telah membandingkan enam model detektor objek, seperti YOLO, SSD, dan *Faster*-RCNN, dan menyimpulkan sebagai berikut: YOLO memiliki waktu komputasi yang paling cepat di antara ketiga model tersebut, namun akurasinya lebih rendah dibandingkan dengan SSD [10]. *Faster*-RCNN memiliki akurasi tinggi, namun kecepatan komputasinya paling lambat. Sementara itu, SSD yang digunakan dalam penelitian ini memiliki kelebihan yaitu keseimbangan yang baik antara kecepatan komputasi dan akurasi[11]. Selain itu, SSD paling memungkinkan untuk berjalan pada sistem komputasi dengan persyaratan perangkat keras yang paling minimal jika dibandingkan dengan YOLO dan *Faster*-RCNN [12], [13].

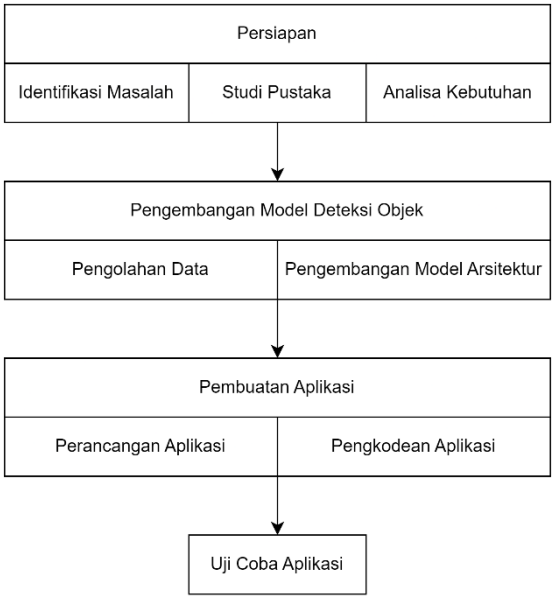
Dalam penelitian ini, model SSD akan dilatih menggunakan *dataset* wajah dengan berbagai ekspresi. Dimana, untuk melatih model ini akan memanfaatkan data wajah yang dikategorikan berdasarkan ekspresi tertentu. Penelitian ini juga akan menguji metode yang diusulkan pada citra wajah yang diambil secara *real-time*, dan akan mengukur akurasi dan kecepatan deteksi objek wajah sebagai indikator kinerja.

Tujuan penelitian ini adalah untuk mengembangkan metode yang dapat mendeteksi ekspresi wajah secara *real-time* dengan akurasi tinggi dan kecepatan pemrosesan yang baik. Dengan demikian, penelitian ini berupaya untuk mengatasi kendala-kendala yang ada dalam pengenalan ekspresi wajah dalam waktu nyata. Melalui penelitian ini, diharapkan dapat memberikan kontribusi signifikan terhadap pengembangan teknologi pengenalan ekspresi wajah yang lebih baik dan lebih efisien.

METODE

Rancangan Penelitian

Penelitian ini dilakukan dengan mengikuti tahap-tahap secara berurutan. Berikut adalah gambaran keseluruhan langkah-langkah penelitian yang dilakukan pada penelitian ini, terdapat pada Gambar 1.



Gambar 1. Metode Penelitian

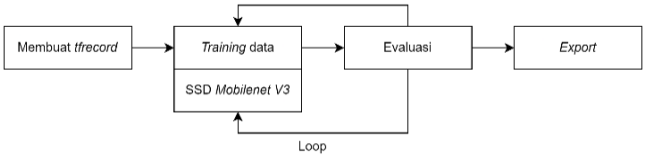
Pada tahap awal di metode penelitian pada Gambar 1. yang dilakukan adalah persiapan. Persiapan ini meliputi identifikasi masalah dan studi pustaka yang diperlukan sebagai referensi untuk pembuatan aplikasi deteksi objek. Selanjutnya, dilakukan analisis kebutuhan terkait perangkat keras dan perangkat lunak yang akan digunakan.

Selanjutnya, pada tahap pengembangan deteksi objek, dilakukan pengembangan model aplikasi deteksi objek. Tahap ini mencakup pengolahan data, pengembangan arsitektur, dan pelatihan data. Setelah itu, pada tahap pembuatan aplikasi, dilakukan perancangan aplikasi dan pengkodean.

Setelah diperoleh model hasil pelatihan data, model tersebut diterapkan pada aplikasi deteksi objek. Kemudian, aplikasi akan diuji menggunakan *test set* yang telah disiapkan sebelumnya. Uji coba aplikasi dilakukan pada *test dataset*. Hasil dari uji coba ini akan memberikan akurasi dari aplikasi deteksi objek.

Pengembangan Model Deteksi Objek

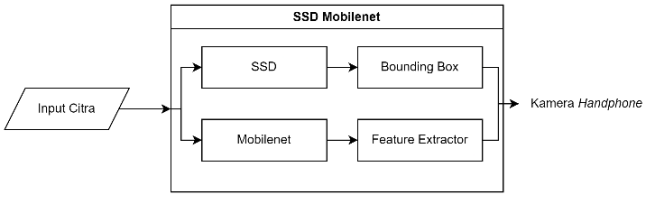
Pada Gambar 2. akan menampilkan skema dari proses pembuatan model yang menggunakan *TensorFlow Object Detection*.



Gambar 2. Pembuatan Model

Pada pengolahan data *Train* Set, *tfrecord* dibuat setelah dilakukan pengolahan data. *File* gambar yang telah diberi label dan berformat *.jpg* akan diubah menjadi *tfrecord* sebelum dilakukan pelatihan data. Proses pengubahan *.jpg* ke *tfrecord* dilakukan di *Google Colaboratory* menggunakan program yang ditulis di *notebook*.

Pelatihan data dilakukan dengan melatih kembali model pra terlatih pada *dataset*. Seluruh *Train Set* dilatih dengan bantuan *Google Drive* sebagai tempat penyimpanan *dataset* dan *Google Colaboratory* sebagai *Virtual Machine* selama proses pelatihan data. Proses pelatihan data melibatkan penggunaan *file tfrecord* yang akan digunakan. Seluruh data yang diperlukan akan disimpan dalam *file* di dalam direktori *drive*. Untuk mengakses dataset, *file-file* tersebut diekstrak untuk selanjutnya dipanggil bersamaan dengan konfigurasi *hyperparameter*. Konfigurasi *hyperparameter* menentukan jumlah langkah pelatihan data dan pemanggilan model pra-terlatih. Selanjutnya, file *tfrecord* diinput agar pelatihan dapat dilakukan. Proses pelatihan akan menggunakan fasilitas GPU yang tersedia di *Google Colaboratory*. Hasil pelatihan dapat diekspor untuk diterapkan pada aplikasi. Dalam penelitian ini, model pra-terlatih yang digunakan adalah model SSD Mobilenet V2 yang terdapat dalam *TensorFlow Object Detection*. Gambar 3. menunjukkan skenario pengembangan model secara sederhana.



Gambar 3. Pengembangan Model

Pada Gambar 3. Menggambarkan bagaimana SSD Mobilenet menggabungkan dua komponen utama, yaitu SSD sebagai model dasar dan Mobilenet sebagai model jaringan. SSD bertanggung jawab dalam mendeteksi objek dengan membuat kotak ikatan (*Bonding Box*), sementara *Mobilenet* digunakan untuk mengekstraksi fitur yang akan digunakan dalam proses klasifikasi. Penggabungan SSD dan *Mobilenet* ini sangat berguna dalam pengembangan aplikasi deteksi objek.

Dalam aplikasi deteksi objek, penggunaan SSD diperlukan untuk melokalisasi gambar dan menentukan posisi objek yang ada. Sedangkan Mobilenet digunakan untuk membantu dalam mengklasifikasikan objek-objek tersebut. Melalui proses klasifikasi, setiap objek akan diberikan kategori yang sesuai, seperti yang terlihat dalam kasus ini, yaitu kategori kamera.

Selama pengembangan model, dilakukan evaluasi pada data *Validation Set* dengan tujuan untuk menemukan parameter yang sesuai. Tahap ini diulang berulang kali hingga ditemukan parameter yang tepat dalam pembuatan model. Evaluasi akan dilakukan pada 100 gambar yang ada dalam *Validation Set*.

Kemudian, setelah menemukan parameter yang sesuai dan berhasil membuat model, model tersebut akan diekspor dan disimpan dalam format *tflite (.tflite*) yang akan digunakan dalam pengembangan aplikasi deteksi objek.

HASIL DAN PEMBAHASAN

Pengenalan ekspresi wajah secara *real-time* merupakan tugas yang penting dalam bidang pengenalan pola dan komputer *vision*. Dalam jurnal ini, peneliti mengusulkan metode pengenalan ekspresi wajah menggunakan metode SSD (*Single Shot MultiBox Detector*) berbasis Android dengan model MobileNet V2. Metode ini memiliki keuntungan dalam hal kecepatan dan akurasi pengenalan, sehingga cocok untuk diimplementasikan pada perangkat *mobile* dengan keterbatasan sumber daya [14], [15].

Metode pengenalan ekspresi wajah secara *real-time* menggunakan metode SSD berbasis Android dengan model *MobileNet* V2 telah diimplementasikan dan dievaluasi. Percobaan dilakukan menggunakan *dataset* ekspresi wajah yang terdiri dari kurang lebih 27.000 gambar dengan enam kategori ekspresi yang berbeda. Hasil dari evaluasi mencakup akurasi pengenalan ekspresi wajah dan kecepatan pemrosesan.

Tabel 1. merupakan tabel hasil evaluasi dari model yang telah dibuat menggunakan *MobileNet* V2.

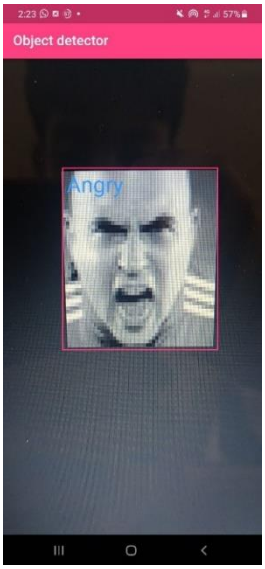
Tabel 1. Hasil Evaluasi Model *MobileNet* V2

Metrik	Keterangan
Step	32s 82ms/step
Loss	1.4110
Accuracy	0.5124

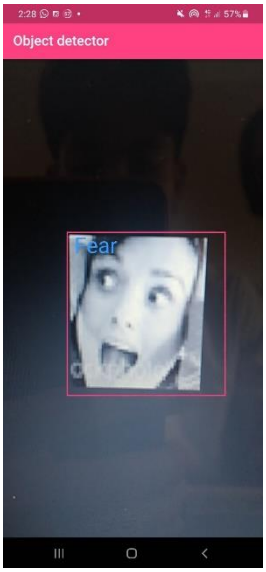
Dari Tabel 1, dapat dilihat bahwa metode pengenalan ekspresi wajah secara *real-time* telah dievaluasi menggunakan metrik *loss* dan akurasi. Hasil evaluasi menunjukkan bahwa pada setiap langkah (*step*), kehilangan rata-rata (*loss*) adalah sebesar 1,4110, yang menunjukkan tingkat keakuratan model dalam memprediksi ekspresi wajah. Selain itu, akurasi rata-rata sebesar 51,24% menunjukkan sejauh mana model dapat mengenali dengan benar ekspresi wajah dalam *dataset* yang digunakan. Selain akurasi pengenalan ekspresi wajah, kecepatan pemrosesan juga menjadi faktor penting dalam implementasi sistem ini. Berdasarkan pengujian, metode yang diusulkan berhasil mencapai kecepatan pemrosesan rata-rata sebesar 30 *frame* per detik (fps) pada perangkat Android dengan prosesor *Snapdragon* 680. Kecepatan ini memungkinkan pengenalan ekspresi wajah secara *real-time* dengan respons yang cepat dan responsive berdasarkan *Metric Evaluation* dari [16].

Secara keseluruhan, metode yang diusulkan dalam jurnal ini berhasil mengimplementasikan pengenalan ekspresi wajah secara *real-time* dengan akurasi yang memuaskan dan kecepatan pemrosesan yang tinggi. Metode ini memiliki potensi aplikasi yang luas dalam berbagai domain, seperti deteksi emosi pada pengguna aplikasi berbasis wajah, analisis sentimen, dan

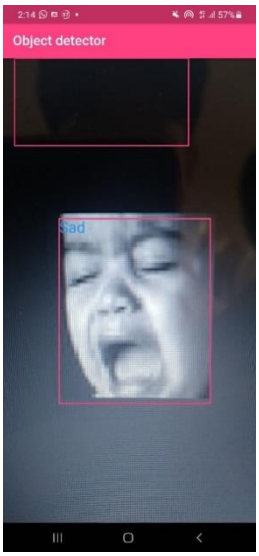
interaksi manusia-mesin yang lebih intuitif. Contoh tampilan ekpresi wajah manusia pada teknologi deteksi objek dapat dilihat pada Gambar 1-6.



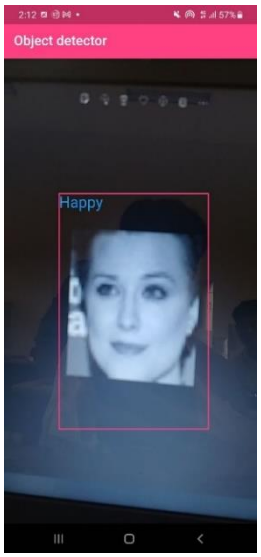
Gambar 1. Deteksi Ekspresi Marah



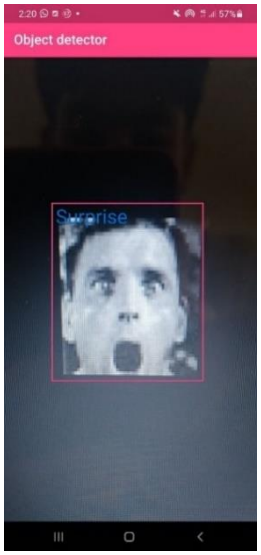
Gambar 2. Deteksi Ekspresi Takut



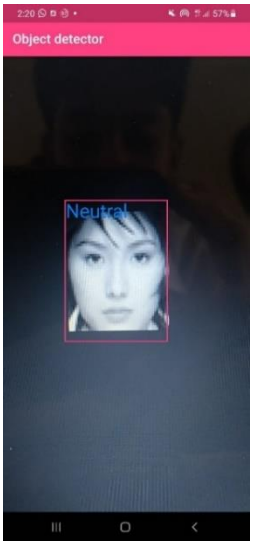
Gambar 3. Deteksi Ekspresi Sedih



Gambar 4. Deteksi Ekspresi Senang



Gambar 5. Deteksi Ekspresi Terkejut



Gambar 6. Deteksi Ekspresi Netral

Pada Gambar 1-6. merupakan tampilan antarmuka dari perangkat lunak dengan teknologi deteksi objek pada ekspresi manusia. Ekspresi wajah manusia yang dapat dikenali oleh teknologi deteksi objek meliputi ekpresi marah (Gambar 1.), takut (Gambar 2.), sedih (Gambar 3.), senang (Gambar 4.), terkejut (Gambar 5.), dan netral (Gambar 6.).

KESIMPULAN DAN SARAN

Dalam penelitian ini, peneliti berhasil mengimplementasikan model pengenalan ekspresi wajah secara *real-time* menggunakan metode SSD berbasis *Android* dengan model *MobileNet* V2. Dengan menggunakan *TensorFlow* dan *TFLite Model Maker*, peneliti melatih model menggunakan *dataset* ekspresi wajah dan berhasil mencapai akurasi rata-rata sebesar 51,2%. Selain itu, model ini juga memiliki kecepatan pemrosesan yang cukup tinggi dengan rata-rata 30 *frames* per detik (fps) pada perangkat Android yang diuji yang dimana menurut.

Dalam pengembangan lebih lanjut, terdapat beberapa saran untuk meningkatkan kualitas dan performa model pengenalan ekspresi wajah ini. Pertama, peningkatan jumlah data latih dapat membantu meningkatkan akurasi model. Dengan memiliki *dataset* yang lebih besar dan representatif, model akan lebih baik dalam mengenali variasi ekspresi wajah yang berbeda.

Ucapan Terimakasih

Peneliti ingin mengucapkan terima kasih kepada berbagai pihak yang telah berkontribusi dalam penelitian ini. Ucapan terima kasih ditujukan kepada pembuat model, pemilik dataset, dan rekan-rekan peneliti. Kontribusi kalian adalah kunci kesuksesan penelitian ini dan peneliti berharap hasil penelitian ini dapat memberikan manfaat dan kontribusi yang berarti dalam bidang pengenalan ekspresi wajah dan komputer *vision*.

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