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PREFACE

Editor of TECHNO(Journal of Computing and Information Technology), said praise and gratitude to the presence of Allah S.W.T, creator of the universe who mastered knowledge as wide as heaven and earth, for the abundance of grace and gifts that have been given to TECHNO editors to publish TECHNO Vol. 21, No. 2 March 2024, which is used by lecturers, researching, and professionals as a medium or media to publish publications on the findings of research conducted in each semester.

TECHNO is published 1 (one) year for 2 (two) times at the end of each semester, TECHNO editors receive scientific articles from the results of research, reports / case studies, information technology studies, and information systems, which are oriented to the latest in science and information technology in order to be a source of scientific information that is able to contribute to the increasingly complex development of information technology.

The editor invited fellow researchers, scientists from various tertiary institutions to make scientific contributions, both in the form of research results and scientific studies in the fields of management, education, and information technology. The editors really expect input from readers, information technology professionals, or those related to publishing, for the sake of increasing the quality of journals as we all hope.

The editor hopes that the scientific articles contained in the TECHNO scientific journal will be useful for academics and professionals working in the world of management, education, and information technology

Chief Editor

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DIAGNOSIS OF CUCUMBER PLANT DISEASES USING CERTAINTY FACTOR AND FORWARD CHAINING METHODS

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Abstract—*Cucumber plants spread and can live in tropical climates like Indonesia. The cucumber plant has many benefits and can be a beauty ingredient. Cucumbers, like other plants, can also have disease attacks, which can threaten farmers. This expert system can help farmers discover diseases that attack cucumber plants and how to control them. The certainty Factor is a method used to measure the certainty of facts to describe an expert's confidence in facing a problem. Forward Chaining is an approach method monitored by data starting from information in the form of facts and supported by rules to reach conclusions. Implementing an expert system for diagnosing cucumber diseases using certainty factor and forward chaining methods will make it easier for farmers and the public to cultivate cucumber plants and get good results. Applying the forward chaining method and factor certainty in this expert system can produce an accuracy level of 95.918%.*

Keywords: *certainty factor, cucumber plant diseases, expert systems, forward chaining.*

Intisari—*Tanaman mentimun merupakan tanaman yang menjalar dan bisa hidup pada iklim tropis seperti Indonesia. Tanaman mentimun memiliki banyak khasiat dan dapat digunakan pada bahan kecantikan. Pada dasarnya mentimun sama seperti tanaman lainnya yang juga dapat memiliki penyakit yang menyerang, hal ini dapat menjadi ancaman bagi para petani. Sistem pakar ini dapat membantu para petani untuk mengetahui penyakit yang menyerang tanaman timun serta cara pengendaliannya. Certainty Factor merupakan metode yang digunakan untuk mengukur kepastian terhadap fakta untuk menggambarkan keyakinan seorang pakar dalam menghadapi masalah. Forward Chaining merupakan metode pendekatan yang dimonitori oleh data dimulai dari informasi berupa fakta dan didukung dengan aturan aturan untuk mendapatkan kesimpulan. Implementasi sistem pakar diagnosis penyakit timun dengan metode certainty factor dan forward chaining ini harapannya dapat memudahkan petani maupun masyarakat dalam membudidayakan tanaman mentimun dan mendapatkan hasil yang baik. penerapan metode forward chaining dan kepastian faktor pada sistem pakar ini dapat menghasilkan tingkat akurasi sebesar 95,918%.*

Kata Kunci: *certainty factor, penyakit tanaman mentimun, sistem pakar, forward chaining.*

INTRODUCTION

Agriculture is the central sector in a country in a tropical region, including Indonesia. Indonesia is known as an agricultural country because it has fertile soil and gets lots of sunlight and high rainfall. Agriculture in Indonesia is the primary source of food security. Food is a sector that humans always need, and Indonesia has quite a large number of consumers. The economic sector can be optimized for cultivating plants and managing their benefits in agriculture (Pardin Lasaksi, 2023). Currently, the direction of agricultural development in Indonesia is towards modern agriculture. Modern agriculture refers to a series of technologies and innovations applied in the agricultural sector, including machinery developments, pest and disease control, and harvest and post-harvest processes. In Indonesia, the technology used to support modern agriculture depends on various factors, including skilled human resources, the availability of high-quality seeds, superior agricultural results, and the

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application of high-tech mechanisms. The advantage of modern agriculture lies in its ability to efficiently overcome current challenges, such as increasingly limited land, by producing abundant results in a relatively short time (Rachmawati, 2021; St Fatmawaty & Bijaksana, 2023).

Cucumber is a horticultural crop that is quite popular in Indonesia and can be managed using modern agricultural technology. Cucumber plants produce fruit, which has consumption value as a food ingredient. Cucumbers are rich in various nutrients such as protein, fat, carbohydrates, calcium, phosphorus, iron, and vitamins A, C, B1, B2, and B6 (Kasmin et al., 2023). Apart from that, cucumbers also contain water, potassium and sodium. One of the health benefits of cucumber is its ability to lower blood pressure. Cucumber fruit can be consumed fresh or further processed into various products. Besides being a food ingredient, cucumbers are also widely used in the beauty industry as raw materials. Even though it has excellent potential, cucumber production in Indonesia is still relatively low. However, cucumber plants are easy to cultivate because they are adaptable to various climatic conditions. With high market absorption, business opportunities in cucumber cultivation are still wide open (Agustin & Gunawan, 2019).

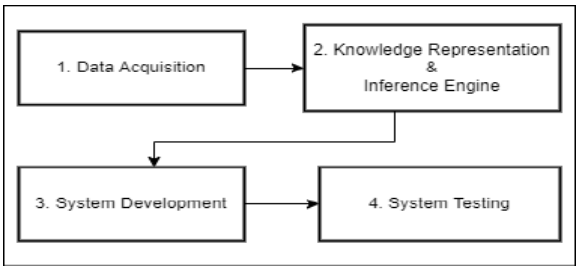
However, current conditions show that the productivity of cucumber plants in Indonesia could be much higher. They were caused by several factors, including climate factors, farming techniques such as tilling the land, fertilizing, irrigation, and pest and disease attacks (Handayani et al., 2020). One solution to overcome this problem, especially early detection of diseases suffered by cucumber plants, is to use the help of information technology in the form of an expert system. Various studies on implementing expert systems for the early detection of plant diseases have been developed recently (Armaya et al., 2022). Research related to the diagnosis of cucumber diseases was carried out by (Rahmi et al., 2019) using the Forward Chaining method for early detection of diseases in cucumber plants. The results of this research show that the resulting accuracy is 89%. Similar research was also carried out by (Armaya et al., 2022) using the Certainty Factor method to diagnose disease early in cucumber horticultural plants. This research shows that the Certainty Factor method can produce an accuracy value of 60% -80%. The research conducted by (Arifin et al., 2021; Pasaribu, 2019) used the Bayesian method to diagnose cucumber plants early in Indonesia. The results of both studies show that this method can be used to diagnose cucumber diseases. The level of accuracy produced by both ranges between 65% - 75%.

Early diagnosis systems for horticultural crops have been researched using expert systems. The majority of methods in expert systems used include Cased Based Reasoning (CBR) (Aldo et al., 2022), Forward Chaining (Alamsyah & Nonci, 2023; Suradi et al., 2023), Bayesian (Pasaribu, 2019), and Certainty Factor (Damayanti, 2020; Safitri & Murtiwiyati, 2023). However, each method has advantages and disadvantages. Based on most existing research, Certainty Factors and Forward Chaining methods perform well in diagnosing diseases in horticultural crops, including cucumbers.

Therefore, in this research, early disease diagnosis in cucumber plants used a combination of the Forward Chaining and Certainty Factor methods. The aim of doing this combination is to get better diagnostic results. There are two contributions to this research. First, the system built can help carry out early diagnosis of cucumber plants with accurate results. These two studies can be a reference in developing an expert system, especially for early diagnosis of cucumber plant diseases, which can later be used to help the agricultural sector in Indonesia.

MATERIALS AND METHODS

This section will discuss materials and methods with the flow of this research, which is divided into four main stages: Data Acquisition, Knowledge Representation, System Development and System Testing. Following figure 1 is the research workflow.



Source : (Research Results, 2024)

Figure 1. The Research Workflow

The following each step in this research are explained in points A to D.

A. Data Acquisition

Data acquisition is the initial stage in research. At this stage, data was collected to develop this expert system in the form of data on types of diseases in cucumber plants and supporting symptom data obtained from interviews with some horticultural plant experts at one of the Agricultural Agencies in the Provinces of Yogyakarta and Central Java.

B. Knowledge Representation

Knowledge representation in an expert system refers to the process of coding and storing knowledge information needed to carry out reasoning and decision-making in a particular domain. This representation aims to present the knowledge experts or experts possess in a form that a computer system can understand. Rules are one of expert systems' most commonly used forms of knowledge representation (Sudibyo et al., 2023). Rules consist of conditions (premises) and actions (conclusions) that are implemented if those conditions are met. Semantic networks describe the relationships between concepts in a knowledge domain by using nodes and connections that represent the relationships between these concepts (Hairani et al., 2021; Medianti & Maulana, 2022). After the knowledge representation is formed, the next stage is reasoning using an inference engine.

In this research, the inference engine used is the Forward Chaining method and the Certainty Factor method. The initial factor is the certainty factor, inputted by the expert alongside the rules. The second factor is the certainty level provided by the user. The computation of confidence percentage starts with rules associated with a single symptom. The following is equation 1 to calculate the CF (Certainty Factor) value from experts.

$$CF = [h, e] = MB\ [h, e] - MD\ [h, e] \ldots\ldots\ldots\ldots (1)$$

Where, CF [h,e] = Certainty factor, MB [h,e] = Measure of confidence in hypothesis h, given evidence e (between 0 and 1), and MD [h,e] = Measure of disbelief in hypothesis h, if given evidence e (between 0 and 1). The next process is to carry out calculations using the following equation 2.

$$CF = CF_{user} * CF_{pakar} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

The rules of the Certainty Factor method are as follows (Putra & Yuhandri, 2021; Rahmadhani et al., 2020; Sholeha et al., 2023; Sukiakhy et al., 2022). First, the rules for adding two positive Certainty Factor factors use equation 3.

$$(CF_a CF_b) = CF_a + CF_b * (1 - CF_a) \ldots\ldots\ldots\ldots\ldots (3)$$

The second is rules for adding two negative Certainty Factors use equation 4.

$$(CF_c CF_d) = CF_c + CF_d + (CF_c * CF_d) \ldots\ldots\ldots\ldots\ldots (4)$$

The third is rules for adding positive Certainty Factors and negative certainty factors are more complex using equation 5.

$$(CF_e CF_f) = \frac{CF_e + CF_f}{1 - (|CF_e|, |CF_f|)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

C. System Development

In this research, system development follows the System Development Life Cycle (SDLC) approach, incorporating modelling through use case diagrams within the Unified Modeling Language (UML). Within the UML framework, use cases delineate system requirements and user interactions. Activity diagrams depict flows of activities between users and the system, while class diagrams illustrate object types and static relationships within the system. Sequence diagrams elucidate dynamic interactions among objects or entities within the system.

D. System Testing

The concluding phase of the study involves conducting tests on the system. This phase consists of two distinct scenarios for system testing. Initially, Black Box Testing is employed to assess the functionality of the features within the expert system. Subsequently, the accuracy of the developed expert system is evaluated through various test scenarios, aiming to ascertain its precision by comparing its outputs with those validated by an expert.

RESULTS AND DISCUSSION

In this section, the overall results obtained from this research will be discussed, especially in terms of the expert system developed based on the stages that have been carried out.

A. Data Acquisition

This study exclusively concentrates on the prevalent diseases observed in cucumber plants. The varieties of diseases affecting cucumber plants, as detailed in Table 1 of this expert system, have been the focal point. Furthermore, the disease data acquired underwent validation by horticultural plant experts affiliated with agricultural departments in Yogyakarta and Central Java, as part of this research.

Table 1. Cucumber Plants Diseases

Diseases Code	Diseases Name
P001	Fusarium Wilt
P002	Bacterial Wilt
P003	Leaf Blight
P004	Powdery Mildew
P005	Complex Viruses

Source : (Research Results, 2024)

Table 1 shows that in this study there were five cucumber plant diseases developed in the expert system in this study. In addition, it is also equipped with data on symptoms of cucumber plant diseases. The types of cucumber plant diseases

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symptoms found in this expert system are described in Table 2. In addition, the symptom data obtained has also been validated by horticultural plant experts affiliated with agricultural departments in Yogyakarta and Central Java, as part of this research.

Table 2. Cucumber Plants Diseases Symptoms

Symptoms Code	Symptoms Name
G001	Withered leaves
G002	Yellowing Leaf Stems
G003	Wilted Stems Excrete White Mucus
G004	Yellowing Leaves
G005	Moldy Leaves
G006	Leaves Blight Easily
G007	Leaves Turn Yellow and Dry Up
G008	There are white or moldy spots
G009	The surface of the striped leaves is light green
G010	Small Plants
G011	Yellow Spots Spreading to the Petioles
G012	Completely wilting of leaves
G013	Pale Green Stripes on the Grooved Surface of the Leaves
G014	Dried leaves
G015	Attacking Young Plants

Source : (Research Results, 2024)

Based on the results of interviews with cucumber plant experts, Table 3 shows that there are fifteen disease symptoms that are often encountered.

B. Knowledge Representation

Based on the disease data and symptoms obtained, the next step is to create a knowledge base using the Forward Chaining method with the IF [premise] THEN [result] rule. In this study, using the forward chaining method, if there is a symptom or complaint, then the result is the name of the disease. Meanwhile, the AND operator (&) is the link for each symptom entered by the patient/user. Based on the rules above, the statement is in the form IF [symptom 1] AND (&) [symptom 2] THEN [name of disease]. The relationship rules are described in Table 3 below.

Table 3. Knowledge Base

Rules	Condition
R1	IF G001, AND G002, AND G011 THEN P001
R2	IF G001, AND G003, AND G012 THEN P002
R3	IF G001, AND G004, AND G005, AND G006, THEN P003
R4	IF G006, AND G007, AND G008, AND G015 THEN P004
R5	IF G009, AND G010, AND G013, AND G014 THEN P005

Source : (Research Results, 2024)

Next, calculations will be carried out using the certainty factor method inference machine, which determines the certainty value and uncertainty value. The initial stage is determining the weight value for each symptom based on the MB trust value, which is a trust value, so the more significant the MB value, the greater the expert's trust. The belief value (MB) can be seen in Table 4 below.

Table 4. The belief value (MB)

No	The Belief Value	MB
1.	Definitely Not Sure	0,0
2.	Not Sure	0,2
3.	Maybe Yes	0,4
4.	Most Likely Yes	0,6
5.	Almost Certainly Yes	0,8
6.	Definitely Yes	1,0

Source : (Research Results, 2024)

Apart from determining the trust value, it is also necessary to determine the disbelief value or MD value, where the more significant the MD value, the smaller the trust value. The MD value can be seen in Table 5 below.

Table 5. The Disbelief value (MD)

No	The Belief Value	MD
1.	Definitely Not Sure	1,0
2.	Not Sure	0,8
3.	Maybe Yes	0,6
4.	Most Likely Yes	0,4
5.	Almost Certainly Yes	0,2
6.	Definitely Yes	0,0

Source : (Research Results, 2024)

The next stage is to determine the knowledge base value where there is disease, symptom, MB, MD and CF data where the MB and MD values are obtained by experts through expert interpretation values. In contrast, the CF value is

obtained from the calculation of MB minus MD. The knowledge base value can be seen in Table 6 below.

Table 6. Knowledge Base Accompanied by CF Values

Diseases Code	Symptoms Code	MB Value	MD Value	CF Value
P001	G001	1,0	0,0	1,0
	G002	0,8	0,2	0,6
	G011	0,8	0,2	0,6
P002	G001	1,0	0,0	1,0
	G003	0,8	0,2	0,6
	G012	0,8	0,0	0,8
P003	G001	1,0	0,0	1,0
	G004	1,0	0,4	0,6
	G005	1,0	0,2	0,8
	G006	1,0	0,2	0,8
P004	G006	1,0	0,2	0,8
	G007	0,6	0,0	0,6
	G008	1,0	0,0	1,0
	G015	1,0	0,2	0,8
P005	G009	0,6	0,2	0,4
	G010	0,8	0,0	0,8
	G013	0,6	0,0	0,6
	G014	1,0	0,2	0,8

Source : (Research Results, 2024)

The next stage is to calculate using the certainty factor method, where the user will input data on symptoms that attack cucumber plants. The following is an example of calculations for diagnosing cucumber plant diseases using the certainty factor method.

An example of a disease that will be used as a calculation sample is Leaf Blight. The MB and MD values for leaf blight are known, with data on the MB and MD values obtained from interviews with experts, which can be seen in Table 7 below.

Table 7. MD and MB Values (from Expert) for Leaf Blight

No	Symptoms	MB	MD
1.	Withered leaves (G001)	1,0	0,0
2.	Yellowing Leaves (G004)	1,0	0,4
3.	Moldy Leaves (G005)	1,0	0,2
4.	Leaves Blight Easily (G006)	1,0	0,2

Source : (Research Results, 2024)

To get the expert CF value, we can use the following equation (1), which is accompanied by an explanation.

$$CF\ [h,e] = MB\ [h,e] - MD\ [h,e]$$

G001 → $CF = 1{,}0 - 0{,}0 = 1{,}0$

G004 → $CF = 1{,}0 - 0{,}4 = 0{,}6$

G005 → $CF = 1{,}0 - 0{,}2 = 0{,}8$

G006 → $CF = 1{,}0 - 0{,}2 = 0{,}8$

In the certainty factor method, the CF value is from experts and based on system user input. The following is a sample of CF user data entered in Table 8.

Table 8. CF Values from User

No	Symptoms	CF User
1.	Withered leaves (G001)	Most Likely Yes (0.6)
2.	Yellowing Leaves (G004)	Maybe Yes (0.4)
3.	Moldy Leaves (G005)	Most Likely Yes (0.6)
4.	Leaves Blight Easily (G006)	Almost Definitely Yes (0.8)

Source : (Research Results, 2024)

The next stage is to calculate the CF value for each symptom by multiplying the expert's CF by the user's CF using the following equation (2) with an explanation.

$$CF\ Gejala = CF\ [user] * CF\ [pakar]$$

G001 → $CF = 0{,}6 * 1{,}0 = 0{,}6$
G004 → $CF = 0{,}4 * 0{,}6 = 0{,}24$
G005 → $CF = 0{,}6 * 0{,}8 = 0{,}48$
G006 → $CF = 0{,}8 * 0{,}8 = 0{,}64$

Next, calculate the combination of CF values for each symptom using the following equation (3) (4) and its explanation.

$$CF\ Combine = CF\ old + CF\ gejala * (1 - CF\ old)$$

$$\begin{aligned} CF\ (1,2) &= 0{,}6 + 0{,}24 * (1{,}0 - 0{,}6) \\ &= 0{,}6 + 0{,}24 * 0{,}4 \\ &= 0{,}6 + 0{,}096 \\ &= 0{,}696 \end{aligned}$$

$$\begin{aligned} CF\ (3,4) &= 0{,}696 + 0{,}48 * (1{,}0 - 0{,}696) \\ &= 0{,}696 + 0{,}48 * 0{,}304 \\ &= 0{,}696 + 0{,}14592 \\ &= 0{,}84192 \end{aligned}$$

$$\begin{aligned} CF\ (4,5) &= 0{,}84192 + 0{,}64 * (1{,}0 - 0{,}84192) \\ &= 0{,}84192 + 0{,}64 * 0{,}15808 \\ &= 0{,}84192 + 0{,}1011712 \\ &= 0{,}9430912 \end{aligned}$$

Based on these calculations, it can be seen that the diagnosis result with the highest level of confidence in the type of disease on cucumber plants is Leaf Blight, with a CF value percentage of 94.3%.

C. System Development

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Within system development, the implementation of interfaces stands as a crucial stage, ensuring the alignment of user requirements with system interactions. Effective interface design profoundly aids users in comprehending system operations, thereby enhancing overall system efficiency. This section will present two key interface features integrated into the developed system: the diagnosis page interface and the diagnostic results page interface.

The diagnosis interface page facilitates symptom selection and condition specification, requiring users to designate their relevant symptoms to initiate system processes. Figure 2 illustrates the specifics of the diagnostic page interface.

Source : (Research Results, 2024)

Figure 2. The Diagnostic Page Interface

The diagnosis outcomes exhibit selected symptoms represented through CF and percentage values, accompanied by descriptions, visuals, and recommendations for managing the disorder. Further elaboration on the interface specifics for the diagnosis results page is depicted in Figure 3.

Source : (Research Results, 2024)

Figure 3. The Diagnostic Results Page Interface

D. System Testing

The last phase of the study involves system testing, which is delineated into two distinct scenarios. Initially, Black Box Testing is conducted to assess the functionality of the features within this expert system. Subsequently, the outcomes of the Black Box testing are presented in Table 9.

Table 9. Black Box Testing Results

No	Features	Scenarios	Results
1	Admin Login	Enter the registered username and password	Valid.
		Entering an unregistered username and password	Valid.
2	Diseases Data	Enter fault data	Valid.
		Editing fault data	Valid.
		Delete tampering data	Valid.
3	Symptoms Data	Enter symptom data	Valid.
		Edit symptom data	Valid.
		Delete symptom data	Valid.
4	Knowledge Data	Input knowledge data	Valid.
		Edit knowledge data	Valid.
		Deleting knowledge data	Valid.
5	Admin	Enter admin data	Valid.
		Edit admin data	Valid.
		Delete admin data	Valid.
6	Logout	Pressing the logout button	Valid.
7	Diagnosis	Choose the condition of the symptoms you are experiencing, then click the process button	Valid.

Source : (Research Results, 2024)

After conducting the tests, it can be concluded that the features embedded within this expert system have functioned smoothly. The findings presented in Table 10 affirm the absence of errors across all test scenarios executed. Subsequently, the accuracy of the developed expert system is evaluated through various test scenarios, aiming to validate its precision against expert-validated outputs. Table 11 provides an instance of the sample of accuracy testing scenario conducted within the expert system.

Table 11. Samples of Accuracy Testing Scenario

Symptoms	Manual	System	Expert	Results
• Withered leaves (G001) • Yellowing Leaves (G004) • Moldy Leaves (G005) • Leaves Blight	Leaf Blight (0,9432)	Leaf Blight (94.3 %)	Leaf Blight	Valid

Symptoms	Manual	System	Expert	Results
Easily (G006)				
• Wilted leaves (G001) • Yellowing of leaf stems (G002) • Yellow spots spreading to the petiole (G011)	Fusarium wilt (0,9027)	Fusarium wilt (90%)	Fusarium wilt	Valid

Source : (Research Results, 2024)

The objective of accuracy testing is to evaluate the proficiency of the expert system in delivering diagnoses for different types of cucumber diseases. At this stage, five cases encompassing diverse symptoms and diseases are employed to assess the accuracy of expert analysis values, which are then juxtaposed with the actual results obtained from the expert system. Out of the total five cases evaluated, all demonstrated consistency between the system diagnosis and the expert diagnosis. Then the accuracy value of this expert system can be calculated using the following equation 6.

$$Accuracy = \frac{True\ Diagnosis}{All\ Diagnosis} * 100\% \text{.....(6)}$$

$$Accuracy = \frac{5}{5} * 100\%$$

$$Accuracy = 100\ \%$$

Upon reviewing the test outcomes, it can be deduced that the accuracy percentage obtained from the comparison of expert systems in diagnosing cucumber diseases utilizing the forward chaining method and certainty factor stands at 100%. This research has limitations related to the data used which was only obtained in the Yogyakarta and Central Java area.

CONCLUSION

The following conclusions were drawn based on the results of research on an expert system for early diagnosis of diseases in cucumber plants using the Forward Chaining Method and the Certainty Factor Method. First, the expert-based system being developed can help provide diagnostic results that are carried out before complaints arise and will be detected early to provide early prevention of disease in cucumber plants, which could be more severe. Second, applying the forward chaining method and Certainty Factors in this expert system can produce an accuracy level of around 90% to 94.3%. An expert, a horticultural crop expert affiliated with the agricultural department in Yogyakarta and Central Java, has also validated these results as part of this research. This research has limitations related to the data used which was only obtained in the Yogyakarta and Central Java area. Suggestions for further research are to add data from various regions and form a more accurate knowledge base by adding data on symptoms and disorders from various experts to produce a better diagnosis process.

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COMPARATIVE ANALYSIS OF AUTOMATION FUNCTIONAL TESTING TOOLS PERFORMANCE FOR PLAYSTORE APPS WITH DIA METHOD

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Abstract—*The complexity of smartphone applications presents challenges for developers, who must ensure flawless functionality despite limitations such as budget and time constraints. Manual testing is time-consuming, prompting a shift towards automated testing methods to ensure efficiency and reliability. In this context, researchers are evaluating the efficacy of three leading test automation frameworks—Robot Framework, Katalon Studio, and UI Path—against key performance parameters. Using the Distance to the Ideal Alternative (DIA) method on playstore apps. The main performance parameters used as a reference are automated testing progress and tools usability. Katalon Studio emerges as the top performer, securing the top rank with a remarkably close to the alternative ideal positive distance (Ri) value of 0.00001. UI Path occupies the second position with a Ri value of 0.00135, while Robot Framework trails behind with a Ri value of 0.00295. This research contributes to the understanding of the performance of different automation frameworks in the context of functional testing, providing valuable insights for developers and organizations seeking to optimize their testing processes. The findings underscore the significance of Katalon Studio's exceptional performance and highlight opportunities for improvement in UI Path and Robot Framework. Additionally, implementing a robust monitoring and evaluation framework is crucial for tracking the ongoing performance and optimizing the efficiency of these automation frameworks.*

Keywords: *automation, DIA method, playstore, testing.*

Intisari—*Kompleksitas aplikasi ponsel cerdas menghadirkan tantangan bagi pengembang perangkat lunak, yang harus memastikan fungsionalitas aplikasinya sempurna meskipun terdapat keterbatasan seperti anggaran dan waktu. Pengujian secara manual akan membutuhkan banyak waktu, sehingga mendorong pengembang beralih ke metode pengujian otomatis untuk memastikan efisiensi dan keandalan pengujian. Dalam penelitian ini, peneliti mengevaluasi kinerja tiga test automation framework yaitu Robot Framework, Katalon Studio, dan UI Path untuk pengujian pada aplikasi playstore. Parameter kinerja utama yang dijadikan acuan adalah automated testing progress dan tools usability. Metode yang digunakan pada penelitian ini adalah metode Distance to the Ideal Alternative (DIA). Penelitian menunjukkan bahwa kinerja terbaik dicapai oleh Katalon Studio yang menempati peringkat teratas karena memiliki jarak terdekat dari nilia positif ideal alternatif (Ri) yaitu 0,00001. UI Path menempati posisi kedua dengan nilai Ri sebesar 0,00135, sedangkan Robot Framework berada di posisi kedua dengan nilai Ri sebesar 0,00295. Penelitian ini berkontribusi pada pemahaman kinerja berbagai test automation framework untuk pengujian fungsional serta memberikan wawasan bagi pengembang perangkat lunak dan organisasi yang ingin mengoptimalkan proses pengujian aplikasi yang digunakan. Haisl penelitian ini menunjukkan bahwa kinerja Katalon Studio melampaui UI Path dan Robo Framework. Lebih jauh diperlukan monitoring terhadap perkembangan ketiga framework agar secara berkala dilakukan komparasi ulang agar dapat memastikan keandalan ketiga framework secara periodik.*

Kata Kunci: *otomatisasi, metode DIA, playstore, pengujian.*

INTRODUCTION

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The ubiquitous nature of mobile applications (apps) in critical domains like finance, healthcare, and logistics has spurred a surge of interest in the field of automated mobile app testing. This emphasis reflects the growing recognition of the necessity for robust and efficient quality assurance methodologies in the mobile app development lifecycle (Lin et al., 2020). To synchronize development velocity with software release cycles, a paradigm shift towards test automation is essential for achieving alignment with the software development life cycle. Traditional manual testing methodologies are demonstrably inadequate in high-quality software engineering due to their inherent limitations in covering all potential bug manifestations (Salam et al., 2022). Developers face limitations like budget, time, and resources, often releasing apps quickly under market pressure. These apps need to function across various systems and user actions, requiring extensive testing – a time-consuming task. Unsurprisingly, apps often malfunction or struggle with unexpected user behavior. This not only frustrates users and reduces perceived convenience, but also damages developer reputations (Baktha, 2020).

Mobile app development needs testing to be secure, reliable, and work smoothly. This means using special testing methods designed for mobile devices, beyond just basic functionality checks. Testers can do this manually, but with the fast-paced app market, automated testing using scripts is preferred for speed and efficiency (Menegassi & Endo, 2020). In automation testing, software errors are caught by running automated scripts, rather than having a person manually perform test cases. This approach is faster, more reliable, and yields more accurate results, ensuring the software meets quality standards (Karlsson et al., 2021). Given the abundance of test automation tools and the need for quick, reliable testing in the playstore, automation testing is the preferred method for playstore-based applications (Aslam et al., 2022).

Researchers are evaluating how well different tools automate functional testing for the popular Bizhare investment platform. Launched in 2018 and known for its user-friendly interface, Bizhare enjoys high ratings on Playstore. This study compares three top-performing test automation frameworks: Robot Framework, Katalon Studio, and UI Path. It focuses on three key performance parameters: the number of test cases covered, the time complexity of test execution, and overall execution speed (Berihun et al., 2023).

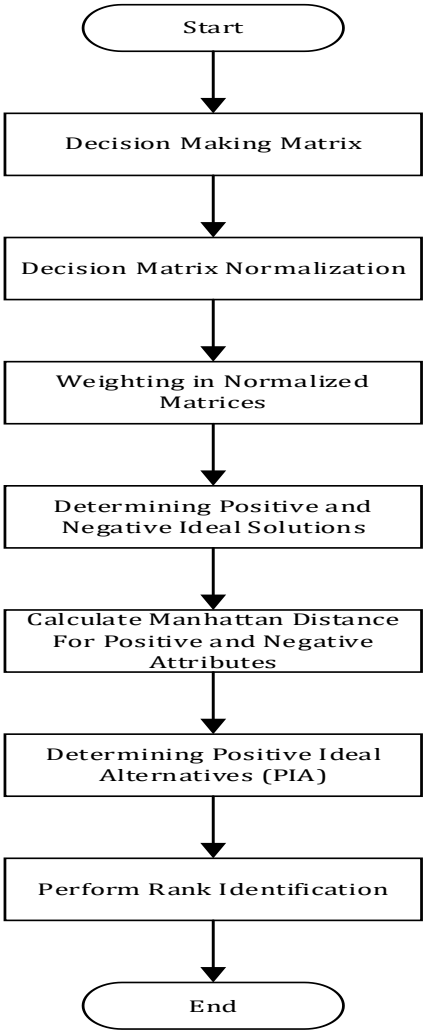
To identify the best framework based on these criteria, the researchers will employ the Distance to the Ideal Alternative (DIA) method. Previous research demonstrates that DIA outperforms other common methods like TOPSIS, SAW, and WP in its ability to accurately rank alternatives, particularly when dealing with ranking abnormalities (Abdulwareth & Al-Shargabi, 2021). This suggests DIA will provide a more nuanced and reliable comparison of the three frameworks. Following the suggestions provided in previously researched references, the researcher opted to utilize the Distance to the Ideal Alternative method in this study.

MATERIALS AND METHODS

The research design underwent multiple stages as outlined below (Arya et al., 2021):

1. Data collection
   The gathered data consists of literature concerning the DIA method, along with specifications for Robot Framework, Katalon Studio, and UI Path, aimed at evaluating their effectiveness as tools for automation functional testing.
2. Identify the application
   The Playstore application used as a test object is Bizhare, an investment platform that has been fully operational since 2018.
3. Design test scenarios (*test case*)
   The scenario design used is testing the login feature with 5 scenarios, namely 4 negative scenarios (failed login) and 1 positive scenario (successful login). The four negative scenarios are app login with an empty password, app login with an empty email, app login with an incorrectly formatted email and app login with an incorrect email and password. Meanwhile, one positive scenario is app login provided the app login is successful.
4. Emulator settings
   To carry out automatic functional testing for mobile applications, an emulator or real device is needed that is compatible with the operating system. In this research, the author chose to use an Android-based real device. By using a real device, the author only needs to connect using a data cable and set the device to Developer Mode.
5. Implementation automation functional testing
   The general steps for automation functional testing are setting up app tools, setting up scripts for test automation scenarios, running tests and generating results. General steps are taken in the three test automation frameworks, namely Robot Framework, Katalon Studio and UI Path.
6. Analysis of determining the best performance decisions for automation functional testing tools using the DIA method.

The calculation flow of The Distance To The Ideal Alternative (DIA) method for selecting the best test automation frameworks is shown in Figure 1.



Source : (Aslam et al., 2022)

Figure 1. Calculation Process Using The Distance To The Ideal Alternative Method

The Distance To The Ideal Alternative (DIA) method is one of the MADM methods, MADM or Multiple Attribute Decision Making itself is a method used to find the optimal alternative from a number of alternatives with certain criteria . The essence of MADM is to determine the weight value for each attribute, then proceed with a ranking process that will select the alternatives that have been given (Chakraborty, 2022). In general, it can be said that MADM selects the best alternative from a number of alternatives. There are several MADM methods such as the SAW, WP, ELECTRE, TOPSIS, and AHP methods. The DIA method itself is a method based on principles such as the TOPSIS method. This method was developed to improve the previous method, namely the TOPSIS method. Metode DIA, a recent addition to the MADM toolbox, shares similarities with TOPSIS in identifying ideal scenarios for each attribute (Zayat et al., 2023). However, it differs in three key ways: 1) DIA uses the Manhattan distance instead of Euclidean distance to measure closeness to the ideal. 2) It defines the Positive Ideal Alternative (PIA) as having at least the highest positive value (*Dj^+)* for each attribute, not just maximizing the sum of weighted values. 3) It ranks alternatives based on the order of their distance values *(Ri)* from both the positive and negative ideal, offering a potentially more robust ranking approach (Al-Gharabally et al., 2021), following are the steps of the DIA method.

1. Determine the decision matrix with assigned weight.

$$X = \begin{bmatrix} x_{11} & x_{21} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix} \quad \text{..... (1)}$$

2. Decision matrix normalization.
   Each element in the matrix is normalized to obtain the normalization matrix r_{ij} which can be calculated as follows:

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \quad \text{..... (2)}$$

   So that the normalized R matrix is obtained

$$R = \begin{bmatrix} r_{11} & r_{21} & \cdots & r_{1n} \\ r_{21} & r_{22} & \cdots & r_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ r_{m1} & r_{m2} & \cdots & r_{mn} \end{bmatrix} \quad \text{..... (3)}$$

3. Weighting on a normalized matrix.
   After the matrix normalization process then determines the matrix *V*, where each element of the matrix *V* is obtained by calculation:

$$V = W_{ij} * X_{ij} \quad \text{..... (4)}$$

   Given the weight $W = w_1, w_2, \ldots, w_n$ so that the weight normalized matrix *V* can be produced as follows:

$$V = \begin{bmatrix} w_1 r_{11} & w_2 r_{21} & \cdots & w_n r_{1n} \\ w_1 r_{21} & w_2 r_{22} & \cdots & w_n r_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ w_1 r_{m1} & w_2 r_{m2} & \cdots & w_n r_{mn} \end{bmatrix} \quad \text{..... (5)}$$

4. Determine positive ideal and negative ideal solutions.
   Similar to TOPSIS, DIA establishes the positive and negative ideal attribute values for each attribute. These values represent the maximum and minimum values of the attributes within each column of the MADM matrix. The positive ideal solution is labeled as A^+ and the negative is labeled as A^- :

$$A^+ = max_j v_{ij} = [v_1^+, v_2^+, v_3^+, \ldots, v_m^+] \quad \text{..... (6)}$$

$$A^+ = min_j v_{ij} = [v_1^-, v_2^-, v_3^-, \ldots, v_m^-] \quad \text{..... (7)}$$

5. Calculate the Manhattan distance for positive and negative attributes.
   While the TOPSIS method employs the positive ideal solution value to compute the Euclidean distance in m-dimensional space between the

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solution and the ideal solution, DIA utilizes the Manhattan distance to calculate the distance between the attribute value and both the positive and negative ideal values of each attribute.

$D_j^+ = \sum_{i=1}^{m}[V_{ij} - a_i^+], for\ i = 1,2,3,\dots,m$ ..... (8)

$D_j^- = \sum_{i=1}^{m}[V_{ij} - a_i^-], for\ i = 1,2,3,\dots,m$ ..... (9)

Where V_{ij} is an element of matrix V and a_i is an element of matrix A.

6. Determine Positif Ideal Alternatif (PIA).
   Than, DIA considers the minimum value D^+ and the maximum value D^-

   $\min D^+ = \min D_j^+ = min_j \sum_{i=1}^{m}[V_{ij} - a_i^+]$ ..... (10)

   $\max D^- = \max D_j^- = min_j \sum_{i=1}^{m}[V_{ij} - a_i^-]$ ..... (11)

   Determine Positif Ideal Alternatif (PIA) which has a minimum D_j^+ , and a maximum of D_j^-, as follows:

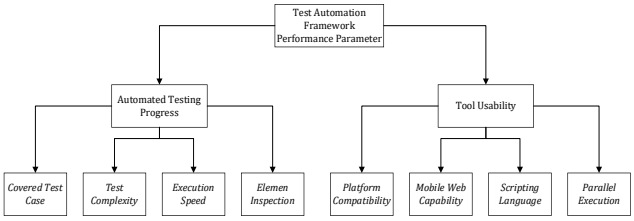
   $PIA = \min(D_j^+), \max(D_j^-)$ ..... (12)
7. Perform Rank Identification.
   The ranking can be determined by looking at the Ri obtained from the PIA alternative distance as follows:

   $R_i = \sqrt{(D_i^+ - \min(D_i^+)^2 + (D_i^- - \min(D_i^-)^2}$ ..... (13)

RESULTS AND DISCUSSION

The analysis process in this study commences with data collection through a literature review, followed by the application of an implementation methodology to identify the target application for automated functional testing. Subsequently, this leads to the formulation of test cases and configuring emulator settings for test preparation. The author utilizes a physical device as the application's working environment, with the Appium server serving as a bridge between the tools and real devices. Through the Appium server, the application ID is obtained, and the application elements utilized in the test case are inspected (Tran et al., 2023). Furthermore, for the implementation of automated functional testing, the Robot Framework, Katalon Studio, and UI Path employ distinct methodologies. The Robot Framework utilizes a console script, while Katalon Studio and UI Path employ a graphical interface.

The complete equation for each stage in The Distance to the Ideal Alternative (DIA) method has been presented in the Literature Review. The author defines parameters and subparameters based on literature studies written by (Aslam et al., 2022; Kozak & Berko, 2022; Prasad et al., 2021). The automatic testing progress parameter has a weight of 0.65, while the tool usability parameter has a weight of 0.35. Figure 2 explains the parameters and sub-parameters as a benchmark for comparison between frameworks.



Source : (Research Result, 2024)

Figure 2. The Parameters And Sub-Parameters As A Criteria

During the assessment of automation software testing, attention is directed towards two primary parameters: Automated Testing Progress and Tool Usability. Below is an explanation of each parameter and sub-parameter.

Table 1. The Parameters And Sub-Parameters Definition

Parameter Sub-Parameter	Definition
Automated Testing Progress	
Covered Test Case	The framework's accuracy in finding elements, so that more tests are passed, thereby minimizing manual testing.
Time Complexity	The total duration of test execution determines whether the framework swiftly executes the multitude of created tests.
Execution Speed	The speed at which the framework performs a command to execute an action. For instance, in a command to click a button.
Elemen Inspector	How each framework carries out inspections to determine the identity of elements, manually or automatically.
Tool Usability	
Platform Compatibility	Framework compatibility for testing applications with various platforms such as Android, IOS, Windows or others.
Mobile Web Capability	The framework possesses the capability to test Web View on application pages.
Scripting Language	Any scripting language applicable for test scripting enhances the flexibility of the framework; the broader the range of programming languages supported within a single framework, the greater its flexibility.
Parallel Execution	Whether the framework has the capability to conduct multiple tests concurrently

Source : (Aslam et al., 2022; Prasad et al., 2021)

Based on the rules of the DIA method, the sum of all weights must be 1, so the weights of each sub-parameter are presented in table 1.

Table 2. Assessment Criteria and Weights

Code	Criteria	Weight	Type
C1	Covered Test Case	0,20	Benefit
C2	Time Complexity	0,15	Cost
C3	Execution Speed	0,10	Cost
C4	Elemen Inspector	0,05	Benefit
C5	Platform Compatibility	0,20	Benefit
C6	Mobile Web Capability	0,15	Benefit
C7	Scripting Language	0,10	Benefit
C8	Parallel Execution	0,05	Benefit

Source : (Research Result, 2024)

After obtaining the *Ri* value and ranking of the two parameters that have been determined, the author will carry out another analysis to compare the values of the two parameters using The Distance To The Ideal Alternative (DIA) method to produce a final value that is more valid for measuring the performance of the test automation framework as a whole. . Furthermore, the ranking results obtained from the comparative analysis of test automation framework performance for functional testing on Playstore-based applications using the DIA method are presented in table 3.

Table 3. Final Ranking Results

Automated Testing Framework	R_i	Rank
Robot Framework	0,00295	3
Katalon Studio	0,00001	1
UI Path	0.00135	2

Source : (Research Result, 2024)

The alternative distance to the Alternative Positive Ideal is called *Ri* . A set of alternatives can be ranked according to the increasing order of *Ri*. The minimum *Ri* value indicates that alternative *Ai* is more selected (Abdulwareth & Al-Shargabi, 2021). Table 3 illustrates the ranking results, with Katalon Studio achieving the top rank with a *Ri* value of 0.00001. This exceptional performance underscores Katalon Studio's dominance in the ranking, as it exhibits the smallest alternative ideal positive distance (*Ri*) value, indicating its proximity to the studied criteria. Katalon Studio's ability to offer comprehensive features for test automation, encompassing test recording, Web, mobile, and API automation, along with robust CI/CD integration, greatly enhances modern software testing practices (Gota et al., 2020). These advantages can be attributed scientifically to a structured approach in software development and provision that caters to the diverse needs of users.

UI Path secures the second position with a *Ri* value of 0.00135, indicating a greater distance from the positive ideal alternative compared to Katalon Studio. UI Path's superiority in GUI-based process automation and robust integration with various testing platforms and environments can be attributed scientifically to a meticulous and adaptive technical approach to evolving test environments and recent technological advancements.

Robot Framework occupies the third position in the ranking with a *Ri* value of 0.00295. Despite being ranked last, Robot Framework's performance can be interpreted scientifically as a result of its focus on flexibility and robust support for various scripting languages, as well as active engagement in a developer community that aids users in overcoming diverse challenges in automated testing.

CONCLUSION

The study conducted by the authors demonstrates a rigorous approach to test case design and functional testing across three prominent automation frameworks. Katalon Studio emerges as the clear frontrunner, securing the top rank with a remarkably low *Ri* value of 0.00001. This near-zero value suggests an exceedingly close proximity to an ideal alternative, indicating Katalon Studio's exceptional performance across various metrics, including automated testing progress and tool usability parameters. UI Path occupies the second position with a *Ri* value of 0.00135, indicating a significant contribution to the testing landscape. Lastly, Robot Framework trails behind with a *Ri* value of 0.00295. Therefore, it can be concluded that Katalon Studio represents an ideal alternative test automation framework regarding performance, considering parameters such as automated testing progress and tool usability.

The authors suggest comparing different test automation frameworks, especially concerning the evaluation of mobile applications, performing functional testing across various platforms, and carrying out functional testing using test automation frameworks that are smoothly integrated into a continuous integration tool like Jenkins. Moreover, they propose exploring additional research paths, such as examining the scalability and adaptability of test automation frameworks across different software development environments. Furthermore, investigating the integration of artificial intelligence and machine learning techniques to improve the effectiveness and precision of automated testing processes would be advantageous.

Additionally, this study should be extended to encompass more intricate test case scenarios while maintaining the same criteria. This approach

is essential for yielding innovative findings in the identification of the optimal automated testing framework through the utilization of The Distance To The Ideal Alternative method.

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EMPLOYEE ACCEPTANCE AND SATISFACTION USING E-OFFICE BY HYBRID MODEL BASED ON TAM & ISSM

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Abstract—*E-Office is an electronic mail application both web-based and mobile with the aim of making it easier for users to send, track, and archive letters. The implementation of E-Office applications within agencies certainly has pros and cons from users so it is necessary to do research to find out how users receive E-Office applications. To analyze user acceptance and satisfaction with E-Office applications, it is necessary to test the factors that influence users in utilizing applications. In this study, testing was carried out by combining two models, namely TAM (Technology Acceptance Model) and ISSM (Information System Success Model). The TAM is a widely used model to evaluate user acceptance of new technologies, while the ISSM was developed to analyze successes or failures in the application of information systems. The research method used is quantitative using questionnaire instruments, then the data is analyzed using the R-Square test. The data collected was 50 and then analyzed using SPSS. The user perception criterion shows a number of 0.740 so that the variables of information quality and system quality have a strong correlation with user perception. While both the criteria for perceived ease of use and user intention show a value above 0.75, which is 0.77 so that the variables of information quality and system quality have a very strong correlation with the perception of ease of use, and the variables of user perception and perception of ease of use have a very strong correlation also to user intentions in using E-Office applications.*

Keywords: *E-Office, ISSM, TAM.*

Intisari—*E-Office merupakan aplikasi surat elektronik baik yang berbasis web maupun mobile dengan tujuan memudahkan pengguna untuk mengirim, melacak, dan mengarsipkan surat. Penerapan aplikasi E-Office di dalam instansi tentu saja memiliki pro dan kontra dari pengguna sehingga perlu dilakukan penelitian untuk mengetahui bagaimana pengguna menerima aplikasi E-Office. Untuk menganalisis penerimaan dan kepuasan pengguna terhadap aplikasi E-Office maka perlu dilakukan pengujian mengenai faktor-faktor yang mempengaruhi pengguna dalam pemanfaatan aplikasi. Dalam penelitian ini pengujian dilakukan dengan menggabungkan dua model, yaitu TAM (Technology Acceptance Model) dan ISSM (Information System Success Model). TAM merupakan model yang banyak digunakan untuk mengevaluasi penerimaan pengguna terhadap teknologi baru, sedangkan ISSM dikembangkan untuk menganalisis keberhasilan atau kegagalan dalam penerapan sistem informasi. Metode penelitian yang digunakan adalah kuantitatif dengan menggunakan instrumen kuesioner, kemudian data dianalisis dengan menggunakan uji R^2. Data yang dikumpulkan adalah 50 dan kemudian dianalisis menggunakan SPSS. Hasil pengujian yang diperoleh adalah kriteria persepsi pengguna menunjukkan angka 0.740 sehingga variabel kualitas informasi dan kualitas sistem memiliki korelasi yang kuat terhadap persepsi pengguna. Sedangkan kriteria persepsi kemudahan penggunaan dan niat pengguna menunjukkan nilai diatas angka 0.75 yaitu 0.77 sehingga variabel kualitas informasi dan kualitas sistem memiliki korelasi yang sangat kuat terhadap persepsi kemudahan penggunaa , dan variabel persepsi pengguna dan persepsi kemudahan penggunaan memiliki korelasi yang sangat kuat juga terhadap niat pengguna dalam menggunakan aplikasi E-Office.*

Kata Kunci*: E-Office, ISSM, TAM.*

INTRODUCTION

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In a company there must be circulation of letters from one unit to another. Letters are circulated in various ways, such as sent manually, sent via e-mail, or even sent using applications like E-Office (Electronic Office). E-Office is an application service developed with the Paperless concept to minimize the use of paper in office administration, correspondence for every employee/official of an institution electronically, and at the same time, one of its features can allow the disposition and preparation of draft letters / service notes can be done by employees anywhere and anytime (Aropah, 2021).

Before technology developed, many companies and agencies were still doing manual mailing activities such as making letter numbers, filing, to the stage of sending letters. When creating a letter number, workers should look back at the previous letter number record before affixing the new letter number. This method is very inefficient and certainly takes a long time to carry out the capture process. In addition, manual mail will be an archive file that must be stored in a large warehouse and become an obstacle when searching for files.

Correspondence activities in an agency have their own urgency. It must be recognized that the management of the company or agency must pay attention to correspondence activities to support work to be easier and more efficient (Yudiana et al., 2021). Of course, this can be helped by the existence of E-Office applications. Even the use of eoffice is not only used in private agencies or companies, but also in government. The paperless philosophy is to use as little paper as possible and digitize documents. The benefits are increased productivity, cost-effective, efficient place and reduce environmental impact.

The implementation of the e-office system is expected to provide many benefits to increase the effectiveness of official correspondence activities (Izzati, 2020) . The eoffice application is expected to make it easier for users to send letters from anywhere, to find out whether the letter has been read by the recipient of the letter, to find out whether the letter has been processed or not, to find out whether the letter was rejected or not, and so on. Not only employees, but leaders will also be helped after using the e-office.

Today many uses of technolomandey are made easier by mobile phones. E-Office can no longer only be operated using a laptop but also using a mobile phone. Workers can approve letters, reject letters, dispose of letters with just one click on the E-Office mobile application. During the implementation of e-office, there are several obstacles such as users or employees experiencing difficulties when operating e-office, so that the correspondence process that should be done through e-office cannot be realized properly (Munzir & Wardany, 2022).

In this context, this study aims to know the acceptance of and satisfaction of workers using E-Office by hybrid model based on Technology Accceptance Model (TAM) & Information System Success Model (ISSM). According to DeLone and McLean, after reviewing TAM during the period 2010-2020, several models such as ISSM and UTAUT are the models that are most widely integrated with TAM models (Al-emran & Shaalan, 2021).

There are several theories of technology acceptance to determine how users receive and use new technologies, such as echnology acceptance model (TAM), task technology fit (TTF), theory of planned behavior (TPB), and unified theory of acceptance and use of technology (UTAUT) (Torku et al., 2021). To determine customer acceptance of information technology in various fields such as mobile commerce, online games, email, banking technology, medical technology, banking technology, etc., TAM has been validated as an active method (Bhardwaj & Bawa, 2021). In the study of adoption and acceptance of information systems and information technology, the Tam model is the most widely used and widely used model (Almaiah & Alismaiel, 2019). In addition, the TAM model is also a model that is widely used to evaluate user acceptance of new technologies (Zhou et al., 2019). To determine user behavior towards the adoption or use of technology is the main goal of this model (Mailizar et al., 2021).

On the other hand, ISSM models are used to see how the quality of an information system can affect users (Shivdas et al., 2020). The ISSM model was developed by DeLone and McLean to analyze success or failure in implementing information systems (Ayu Paramadini & Suzianti, 2021). ISSM is the most widely adapted frameword to determine user satisfaction in using information systems. Initially, user satisfaction is only influenced by two factors, namely information quality and system quality, then service quality is added. The framework has been widely adopted to examine users' intention to adopt new technologies and behaviors. Many studies adopt IS success model to explain consumer satisfaction (Ma, 2021). After ten years this model was used to measure the use and success of information systems, DeLone and McLean update it. This model is formed by six factors but in this study only used 2 factors, namely system quality to technology effectiveness, information quality to measure system success.

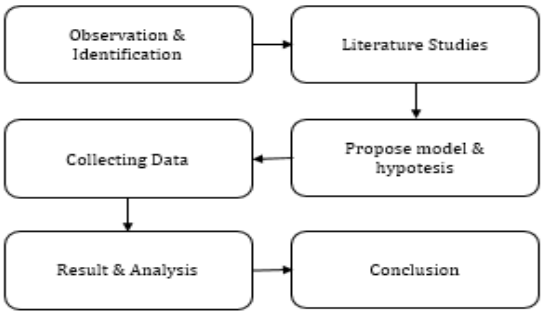
ISSM is a widely used model to measure the success of information systems, where this model explains the use and satisfaction of users both

individually and simultaneously influenced by the quality of information and the quality of the system (Adeyemi & Issa, 2020). Information quality is the quality of output that users can produce through information systems. The variables measured in information quality are accuracy, timeliness, completeness, relevance, and consistency. The quality of information has proven to be a prominent factor for knowing the success of the information system as a whole. While the quality of the system is the usefulness of the features owned by the system. The variables measured in system quality are flexibility, reliability, functionality, ease of use, data importance, integration, and quality (Alzahrani et al., 2019).

MATERIALS AND METHODS

A. Research Model

This research method is completed with the stages of activity in Figure 1.



Source : (Research Results, 2024)

Figure 1. Research Model

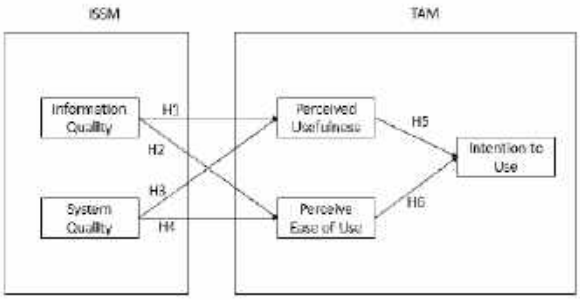
Observation involves direct observation of the way E-Office applications are used in daily practice in the work environment. Some things that need to be observed include how to use the E-Office application by employees, the extent to which the E-Office application helps in improving the efficiency of work processes, and how employees respond to the eOffice system. Then Identification is done to identify the advantages of E-Office implementation, namely what benefits users get from using eOffice. The literature study refers to the collection and analysis of previously published information on implementation, benefits, and trends related to the use of E-Office application, TAM, and ISSM.

The next stage is to propose models and hypotheses. The proposed model is a visual or conceptual representation of the relationship between the variables studied in the study, while the hypothesis is a statement formulated to be tested in the study. The data collection stage used is through questionnaires to collect information from respondents so that an understanding of user perceptions, experiences, and needs of E-Office application is obtained.

Analysis and results are important stages in research that require a deep understanding of the data that has been collected. The initial stage in the analysis is to process raw data that has been collected from the study, conduct data descriptions, conduct statistical analysis to test research hypotheses and answer the research questions posed, interpret the results to conclude research findings, then present the results of the analysis. The last stage is the conclusion, which is a summary of the main findings, implications, and assessment of the research objectives that have been achieved.

B. Propose Model and Hypoteses

The study explores user acceptance and satisfaction for using E-Office applications by combining TAM and ISSM, and incorporates information quality and system quality as external variables. The research method used is quantitative with R2 test analysis techniques. The questionnaire is distributed to E-Office Application users, then analyzed with SPSS. The research model is shown in Figure 2.



Source : (Research Results, 2024)

Figure 2. Proposed Model

In Figure 2 shows the research model in this study. Information quality refers to the reliability, completeness, accuracy, timeliness, and correlation of data generated by information systems. This causes the quality of information can affect perceived usefulness and perceive ease of use. In addition, system quality refers to the features of the system that produce information. The quality of the system has an influence on perceived usefulness and positively affects the perceive ease of use thus affecting the user's willingness to use the system.

This research uses the TAM as a basis, adding information quality and system quality as external variables. The following hypotheses are proposed.

H1: The information quality of E-Office will positively influence on user's perceive usefulness

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H2: The information quality of E-Office will positively influence on user's easy of use
H3: The sytem quality of E-Office will positively influence on user's perceive usefulness
H4: The sytem quality of E-Office will positively influence on user's easy of use
H5: User's perceived usefulness regarding the E-Office will positively influence on their intention to use the system
H6: User's easy of use regarding the E-Office will positively influence on their intention to use the system.

C. Questionnaire Design and Decriptive Statistic

This study explores the user's intention to use E-Office by using questionnaire. The questionnaire is created in Form Office platform. The questionnaire is divided into 6 dimensions and has 20 questions. The data collection technique is carried out by distributing questionnaires via email and whatsapp platform to the workers who use E-Office application.

All items are measured using a 5-point Likert-type scale (1 = strongly disagree, and 5 = strongly agree). The number of correspondents who filled out the questionnaire was 50. The majority of the respondents were mail operator that is equal to 61%, followed by structural officials by 22%, then secretaries by 16%.

Table 1 shows the survey questions and the average value. The average value of each question exceeds 3.5 which indicates that users have good feedback on the E-Office application.

Table 1. Survey Questions and Average Value

Dimension	Survey Questions	Average Value
Information Quality (IQ)	IQ1: I think the information provided by the E-Office application is accurate and reliable	4.28
	IQ2: I think the information provided by the E-Office application is complete and informative	4.18
	IQ3: I think that the E-Office application can display the letter I'm looking for quickly and instantly	4.06
	IQ4: Overall, I am satisfied with the quality of information from this E-Office application	4.08
System Quality (SQ)	SQ1: I think that this E-Office application is sufficient and can meet my needs	4.06
	SQ2: I think that this E-Office application allows me to operate features easily	3.96
	SQ3: I think that the response time for this E-Office application is fast	4.16
	SQ4: I think that the architecture of the E-Office application system is logical	4.06
Perceived Ease of Use (PEOU)	PEOU1: I think I can easily operate this E-Office application	4.16
	PEOU2: I can quickly learn how to operate this E-Office application	4.20
	PEOU3: I think the operating interface of this E-Office application is easy and straightforward	4.04
	PEOU4: Overall, I think this E-Office application is easy to use	4.20
Perceived of Usefulness (PU)	PU1: I think using this E-Office application can help me find the letter I need	4.20
	PU2: I think using this E-Office application can improve work efficiency	4.14
	PU3: Overall, I think using this E-Office application is useful	4.18
Intention to Use (IU)	IU1: I will give priority to use this E-Office application to send letters	4.32
	IU2: I think using this E-Office application to do correspondence is the right choice	4.18
	IU3: I will increase my frequency of using this E-Office application	4.04
	IU4: I will continue to use this E-Office application in the future	4.22

Source : (Research Results, 2024)

RESULTS AND DISCUSSION

It is known that the value of N = 50 ,consist of 22% managerials and 88% mail operators. The data is tested using SPSS software for testing validity and reability. This study assessed the convergent validity and discriminant validity of the constructs. When the factor loading is greater than

0.5, then it can be stated confirming convergent validity. Table 1 shows the result of the convergent validity test using Factor Loading.

Table 1. Convergent Validity Test with Factor Loading

Indicators		Factor Loading	Description
Information Quality (IQ)	IQ1	0.847	Accepted
	IQ2	0.804	Accepted
	IQ3	0.935	Accepted
	IQ4	0.926	Accepted
System Quality (SQ)	SQ1	0.780	Accepted
	SQ2	0.849	Accepted
	SQ3	0.804	Accepted
	SQ4	0.832	Accepted
Perceived Ease of Use (PEOU)	PEOU1	0.880	Accepted
	PEOU2	0.767	Accepted
	PEOU3	0.846	Accepted
	PEOU4	0.856	Accepted
Perceived of Usefulness (PU)	PU1	0.888	Accepted
	PU2	0.829	Accepted
	PU3	0.855	Accepted
Intention to Use (IU)	IU1	0.835	Accepted
	IU2	0.884	Accepted
	IU3	0.831	Accepted
	IU4	0.875	Accepted

Source : (Research Results, 2024)

In Table 1 it can be seen that all factor loading values exceed 0.5 where the smallest value is 0.767 owned by indicator PEOU2 and the largest value is 0.935 owned by indicator IQ3. From the results of these calculations, there are no indicators that have been removed, so there is no need to re-calculate.

Table 2. Convergent Validity Test with AVE

Indicators	AVE	Description
Information Quality (IQ)	77,39%	Accepted
System Quality (SQ)	66.70%	Accepted
Perceived Ease of Use (PEOU)	70.25%	Accepted
Perceived of Usefulness (PU)	73.59%	Accepted
Intention to Use (IU)	73.37%	Accepted

Source : (Research Results, 2024)

When testing convergent validity, it can be measured based on the Average Variance Extracted (AVE). An indicator can be declared to meet convergent validity and have a high level of validity when the Average Variance Extracted (AVE) value is > 0.50. In Table 2 it can be seen that each indicator in the research variables have an AVE value of more than 50%. Therefore, it can be concluded that all research variables have good convergent validity or data can be declared valid.

Table 3. Reliability Analysis with Component Realibility

Indicators	Component Reability	Description
Information Quality (IQ)	0,931	Accepted
System Quality (SQ)	0,888	Accepted
Perceived Ease of Use (PEOU)	0,904	Accepted
Perceived of Usefulness (PU)	0,893	Accepted
Intention to Use (IU)	0,916	Accepted

Source : (Research Results, 2024)

Reliability tests are carried out to prove the accuracy, consistency, and accuracy of instruments in measuring constructs. To be able to have high reliability or can be declared reliable and stable if the value of component realibity must be greater than 0.70. In Table 3 it can be seen that all indicators have component reability value of more than 0.7. It shows that all research variables have a high reliability value.

Table 4. Reliability Analysis with Cronbach's Alpha

Indicators	Cronbach's Alpha	Description
Information Quality (IQ)	0.936	Accepted
System Quality (SQ)	0.887	Accepted
Perceived Ease of Use (PEOU)	0.927	Accepted
Perceived of Usefulness (PU)	0.907	Accepted
Intention to Use (IU)	0.927	Accepted

Source : (Research Results, 2024)

In Table 4 it can be seen that all indicators have cronbach's alpha value of more than 0.7. The smallest CR value is 0.887 owned by indicator SQ and the largest CR value is 0.936 owned by indicator IQ.

After all variables and criteria meet the standards, then the next step is to conduct a hypothesis test. The first thing to do is to find the value of R-Square.

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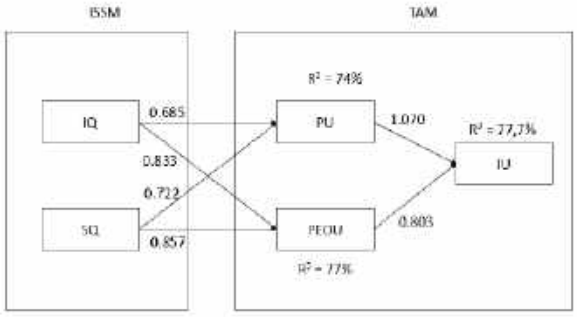
Table 5. R-Square Test

Indicators	R-Square
Perceived of Usefulness (PU)	0.740
Perceived Ease of Use (PEOU)	0.770
Intention to Use (IU)	0.777

Source : (Research Results, 2024)

Based on Table 5 it can be seen that the one with the highest R-Square value is IU which is 0.777 or 77.7%. This means that the ability of independent variables, namely PU and PEOU variables to explain dependent variables IU is 77.7% and the remaining 22.3% is explained by other variables that are not discussed in this study. While the PU variable and PEOU variable are both influenced by IQ and SQ variables. The independent variables IQ and SQ affect the PU bound variable by 74%, while the independent variables IQ and SQ affect the PEOU dependent variable by 77%.



Source : (Research Results, 2024)

Figure 3. Structural Equation Modeling

In Figure 3 can be seen the path of the analysis results. The explanatory power of Perceive Usefulness (PU) is 74%, the explanatory power of Perceive Ease of Use (PEOU) is 77%, and the explanatory power Intention to Use (IU) is 77.7%. IQ to PU shows a value of β=0.685 and p<0.05 so that HI that is the information quality of E-Office will positively influence on user's perceive usefulness is acceptable. And IQ to PEOU shows a value of β=0.833 and p<0.05 so that H2 that is he information quality of E-Office will positively influence on user's easy of use is acceptable.

On the other hand, SQ to PU shows a value of β=0.722 and p<0.05 so that H3 that is the system quality of E-Office will positively influence on user's perceive usefulness, is acceptable. And SQ to PEOU shows a value of β=0857 and p<0.05 so that H4 that is the system quality of E-Office will positively influence on user's easy of use is acceptable. Meanwhile, the PU to IU shows a value of β=1.070 and p<0.05 so that H5 that is user's easy of use regarding the E-Office, will positively influence on their intention to use the system is acceptable. And PEOU to IU shows values β=0.0803 and p<0.05 so that H6 that is user's easy of use regarding the E-Office will positively influence on their intention to use the system is acceptable.

CONCLUSION

The results of this study show that E-Office Applications have a good impact on its users. Procurement of E-Office in an agency can increase the efficiency of mail delivery and save time in tracking the status of letters. Each dimension in the research model proposed in this study has an explanatory power higher than 50%, namely perceive usefulness: 74%, Perceive Ease of Use: 77%, and Intention to Use: 77.7%. Thus the research model can be used as a reference for further research.

Information quality and system quality have a positive influence on perceive usefulness and perceive ease of use. This is indicated when users are satisfied with the quality of information in E-Office applications so that users feel the ease of finding information quickly and accurately through E-Office applications. Meanwhile, system quality also has a good effect that is E-Office applications allow users to operate features easily and the response time is fast.

Furthermore, perceive usefulness and perceive ease of use have a positive influence on intention to use. E-Office applications can help users to find mail and improve user performance so that users can prioritize using E-Office applications to send mail. In addition, the ease of use of E-Office applications makes users feel easy to operate the application so that it can affect the frequency of use of the application. Overall, the user stated that he would continue to use E-Office application in the future.

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PREDICTIVE MODELING OF BROILER CHICKEN PRODUCTION USING THE NAIVE BAYES CLASSIFICATION ALGORITHM

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Abstract—*Serious challenges are faced by broiler chicken farmers in Seumirah Village, Nisam Antara Subdistrict, North Aceh Regency, in their efforts to create high-quality and productive chickens. These difficulties not only impact the farmers' income but also result in recurring losses every year. This research aims to design a system using the Naive Bayes Classifier algorithm to assess the capacity and classify production types based on specific criteria such as population, age, depletion, FCR (Feed Conversion Ratio), IP (Index Performance), and BW (Body Weight). The system aims to classify broiler chicken production as either increasing (profitable) or decreasing (unprofitable). In the development of this predictive system, the PHP programming language is employed, with a MySQL database as the data storage medium. The results of this broiler chicken production prediction system have proven effective in providing information in the form of profit or loss reports based on the harvest results for each monthly period. The implementation of this system is expected to assist in optimizing farmers' production management, increasing business profitability, and providing better guidance for future business decisions. The classification results using the Naive Bayes method indicate an accuracy rate of 86,67 and error rate of 13,3%.*

Keywords: *broiler chicken farming, classification, naive bayes, PHP.*

Intisari—*Tantangan serius telah dihadapi oleh peternak ayam potong di Desa Seumirah, Kecamatan Nisam Antara, dalam upaya menciptakan ayam berkualitas tinggi dan produktif. Kesulitan ini tidak hanya memberikan dampak pada pendapatan peternak, tetapi juga menyebabkan kerugian yang berulang setiap tahunnya. Penelitian ini bertujuan untuk merancang sistem dengan menggunakan metode algoritma Naive Bayes Classifier guna menilai kapasitas dan mengelompokkan jenis produksi berdasarkan kriteria tertentu, seperti populasi, usia, depleksi, FCR (Feed Conversion Ratio), IP (Index Performance), dan BW (Body Weight). Sistem ini dimaksudkan untuk mengklasifikasikan produksi ayam potong, apakah mengalami peningkatan (untung) atau penurunan (rugi). Dalam pengembangan sistem prediksi ini, digunakan bahasa pemrograman PHP, dengan database MySQL sebagai media penyimpanan data. Hasil dari sistem prediksi produksi ayam potong ini terbukti efektif dalam menyajikan informasi berupa laporan keuntungan atau kerugian berdasarkan hasil panen setiap periode bulanan. Dengan adanya implementasi sistem ini dapat membantu manajemen produksi peternak dioptimalkan dan profitabilitas usaha ditingkatkan, serta memberikan panduan yang lebih baik untuk keputusan bisnis di masa depan. Hasil klasifikasi menggunakan metode Naive Bayes menunjukkan tingkat akurasi sebesar 86,67% dan error 13,3%.*

Kata Kunci: *peternakan ayam potong, klasifikasi, naïve bayes, PHP.*

INTRODUCTION

Livestock farming is considered to be a business with promising prospects when developed optimally (Putro et al., 2023). The establishment of livestock businesses aims to enhance production, prioritizing the fulfillment of food and nutritional needs while simultaneously increasing income. Poultry farming in Indonesia has progressed significantly with the emergence of poultry trends such as broiler chickens, laying hens, and ducks, which serve as valuable livestock (Ridwan, 2020). However, the introduction of new poultry types has

not deterred new farmers from choosing broiler chickens as their preferred livestock. Broiler chickens are renowned for their rapid growth, allowing them to yield meat in a relatively short period, typically within 5 to 6 weeks (Hamwar, et al., 2023).

In the village of Seumirah, Nisam Antara Subdistrict, broiler chicken farmers have encountered challenges in achieving productive and high-quality chickens (Mutasar, et al., 2022). These difficulties have not only impacted farmers' income but have also resulted in recurring financial losses (Alita, et al., 2021). In recent times, broiler chicken farmers have experienced annual losses. Addressing these issues necessitates the development of an appropriate livestock husbandry process (Singgalen, 2023). To achieve profitability, farmers are advised to carefully classify and choose materials such as seeds, feed, drugs or vitamins, cage placement, and other factors. This approach is expected to result in healthy broiler chickens with high-quality meat, positively influencing sales and benefiting farmers (Maulana, et al., 2020).

The Naive Bayes method offers several advantages compared to other classification algorithms (Fadhilah, 2020). Firstly, Naive Bayes is computationally efficient and relatively simple to implement. This simplicity also reduces the risk of overfitting, especially when dealing with limited data samples (Hasri et al., 2022). Secondly, Naive Bayes handles both numerical and categorical data well. Additionally, Naive Bayes assumes independence between features, although this may not always hold true in many real-world scenarios (Lishania et al., 2020). However, it often performs well in practice, especially when there are strong feature dependencies.

Previous studies on the Naive Bayes method have demonstrated its effectiveness in various fields, including agriculture and livestock management (Lubis et al., 2021). Researchers have applied Naive Bayes Classifier to predict and classify outcomes based on specific criteria, providing valuable insights for decision-making (Rinestu et al., 2022). The utilization of Naive Bayes in livestock farming, especially broiler chicken production, has shown promise in enhancing classification accuracy and optimizing management practices (Siddik et al., 2020). Research conducted by Septianingrum et al., 2021. In their study, noted that in the era of the Fourth Industrial Revolution, where the internet has become an essential necessity, rapid information dissemination has become common. Sentiment analysis, often employing the Naive Bayes algorithm, is increasingly crucial for understanding public opinion. Through a Systematic Literature Review (SLR), the Particle Swarm Optimization (PSO) feature selection method was considered the most optimal when used alongside the Naive Bayes algorithm, achieving an average accuracy of 89.08%. The research conducted by (Ridwan, 2020) explains that Diabetes Mellitus, or diabetes, is a metabolic disease caused by high blood sugar levels. The study utilized the UCI Machine Learning dataset on Early Stage Diabetes Risk from 2020, comprising 17 attributes. The classification method employed was Naïve Bayes Classification, resulting in an accuracy of 90.20% and an AUC value of 0.95.

In their study, Putra et al. (2022) highlight the high school student selection process, where students are categorized into Science (IPA) and Social Sciences (IPS) streams based on subject averages. They compare Naïve Bayes and K-Nearest Neighbor algorithms for classifying 11th-grade students into IPA and IPS. Utilizing second-semester scores from 277 students in PPKN, History, Crafts, and PAI, Rapidminer facilitated analysis. K-Nearest Neighbor achieved 92.73% accuracy, surpassing Naïve Bayes at 81.82%, aiding schools in precise student classification based on their interests and talents. (Dinata, et al., 2023) conducted research aiming to classify students into normal and partially color blind categories using the Naïve Bayes algorithm. The dataset included 24 Ishihara Tests from students at SMA Negeri 1 Lhokseumawe, totaling 140 data points split into 110 training and 30 testing data. Results indicated 69 students classified as normal and 41 as partially color blind. Testing with the Naïve Bayes Algorithm achieved an accuracy of 86.67% with a 13.33% error rate.

The Naive Bayes Classifier algorithm is one of the classification methods that can be used in prediction systems (Susana, 2022). This algorithm is based on probability and statistics theory, using a set of attributes to predict the class of an object. The algorithm operates by calculating the probability of an object's class based on its attributes, and then determining the class with the highest probability (Handayani & Sulistiyawati, 2021).

Considering the aforementioned issues, the researcher has built upon the foundation laid by previous studies and developed a classification system to determine the best practices in broiler chicken husbandry. The system focuses on indicators such as chicken seeds, feed, drugs or vitamins, and strategic cage environments. The classification is performed using data mining techniques with the Naive Bayes Classifier method. It is hoped that this system will effectively address classification challenges and contribute to the continuous improvement of broiler chicken farming practices. To predict the rise (profit) and fall (loss) of broiler chickens, six criteria are considered: population, age, depletion, FCR (Feed Conversion

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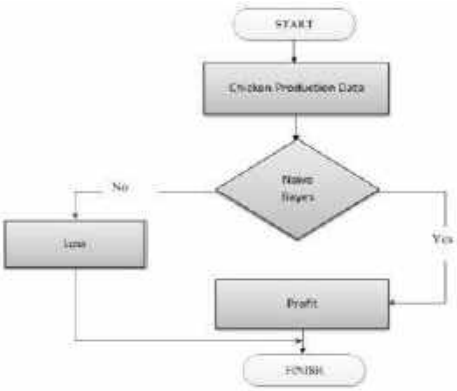
Ratio), IP (Index Performance), and BW (Body Weight).

MATERIALS AND METHODS

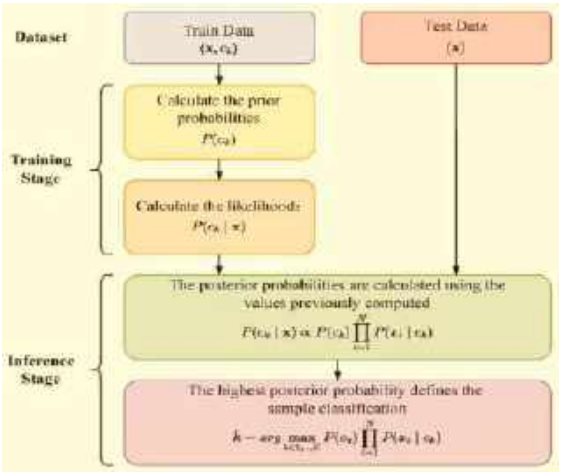
In this research, the data utilized consists of chicken production data. The chicken data will be processed using data mining methods to obtain accurate results that can be used as rules in predicting chicken quality. The following are the stages involved in conducting the research as depicted in the flowchart diagram in Figure 1.



Source : (Research Results, 2024)
Figure 1. Research Flowchart

This study utilizes the Naive Bayes algorithm to classify broiler chicken production data. The research stages employing Naive Bayes are presented as shown in Figure 2.

Based on Figure 2, the Naive Bayes algorithm is a classification method that utilizes Bayes' theorem to categorize objects based on their attributes or features. Its steps involve data collection, computation of class and feature probabilities, and the use of Bayes' theorem to calculate posterior probabilities determining the predicted class. Despite its simplicity with the assumption of independent features, Naive Bayes often yields good results, particularly in text classification and categorization. This model is quickly implementable and effective for predicting the class of an object based on its attribute information.



Source : (Research Results, 2024)
Figure 2. Naïve Bayes Algorithm

RESULTS AND DISCUSSION

Research Dataset

In the research data, six criteria are considered, each designated by a specific code: Population (C1), Age (C2), Depletion (C3), FCR (Feed Conversion Ratio) (C4), IP (Index Performance) (C5), and BW (Body Weight) (C6). These criteria collectively form the basis for analyzing and evaluating various aspects within the study. The data utilized in this research was obtained from a broiler chicken farm in Nisam Village, North Aceh Regency. The details of the data are presented in Table 1.

Table 1. Research Dataset

Dataset	C1 (Population)	C2 (Age)	C3 (Depletion)	C4 (FCR)	C5 IP	C6 BW	Class
A1|January	1000-5000	27-32 Days	0 - 5.00	1400-1700	0-250	1.06 -1.55	1
A10|January	1000-5000	27-32 Days	0 - 5.00	1400-1700	0-250	1.06 -1.55	1
A11|February	1000-5000	33-40 Days	0 - 5.00	1701-2000	0-250	1.06 -1.55	2
A12|February	1000-10000	27-32 Days	0 - 5.00	1400-1700	0-250	1.56 -2.00	1
A13|March	1000-15000	27-32 Days	5.1 - 10.00	1400-1700	301-350	1.06 -1.55	2
A14|April	1000-5000	27-32 Days	0 - 5.00	1400-1700	0-250	1.06 -1.55	2
A15|May	1000-5000	27-32 Days	0 - 5.00	1400-1700	0-250	1.06 -1.55	2
A2|March	5000-10000	33-40 Days	0 - 5.00	1400-1700	301-350	1.56 -2.00	1
A3|April	5000-10000	33-40 Days	15.01 -30.00	1400-1700	0-250	1.06 -1.55	2
A4|April	1000-5000	33-40 Days	0 - 5.00	1400-1700	251-300	1.06 -1.55	2
A5|April	1000-15000	27-32 Days	0 - 5.00	1400-1700	0-250	1.56 -2.00	1
A6|May	1000-10000	27-32 Days	0 - 5.00	1701-2000	0-250	1.06 -1.55	1
A7|May	1000-15000	27-32 Days	10.01 - 15.00	1701-2000	0-250	1.56 -2.00	1
A8|May	1000-5000	33-40 Days	0 - 5.00	1400-1700	0-250	1.56 -2.00	1
A9|May	1000-10000	27-32 Days	5.1 - 10.00	1400-1700	0-250	1.06 -1.55	2

Source : (Research Results, 2024)

The calculation of Naive Bayes

In the manual calculation of broiler chicken production prediction using the Naïve Bayes Classifier algorithm, the process is similar to the calculations performed within the system. Prior to conducting the calculation, a small amount of training data is required to determine the estimated parameters needed in the classification process of predicting whether the production will increase (profit) or decrease (loss). Sample Data (X|May Period) is tested for the A15 May criteria based on the dataset.

Population = 1000-10000
Age = 27-32 Days
Depletion = 5.1 - 10.00
FCR (Feed Conversion Ratio) = 1400-1700
IP (Index Performance) = 251-300
BW (Body Weight) = 1.06 - 1.55

a. Class
Class represents the classification condition of whether the chicken is "Loss" or "Profit."
Class C1: Decreased Production (Loss)
Class C2: Increased Production (Profit)

b. Calculation
P(Ci): P(Chicken Status = Decreased Production)

(Loss)) = 7/15 = 0.4666666.
P(Chicken Status = Increased Production
(Profit)) = 8/15 = 0.5333333.

c. Calculate P(X|Ci) for Each Class:
Population (C1): 1000-10000
P(Population=1000-10000 | Class: Decreased Production (Loss)) = 1/7 = 0.142.
P(Population=1000-10000 | Class: Increased

Production (Profit)) = 2/8 = 0.25
Age (C2): 27-32 Days.
P(Age=27-32 Days | Class: Decreased Production
(Loss)) = 4/7 = 0.5714.
P(Age=27-32 Days | Class: Increased Production
(Profit)) = 6/8 = 0.75.

Depletion (C3): 5.1 - 10.00
P(Depletion=5.1 - 10.00 | Class: Decreased Production (Loss)) = 0/8 = 0.
P(Depletion=5.1 - 10.00 | Class: Increased Production (Profit)) = 2/7 = 0.2857.

FCR (C4): 1400-1700
P(FCR=1400-1700 | Class: Decreased Production
(Loss)) = 6/7 = 0.8571.
P(FCR=1400-1700 | Class: Increased Production
(Profit)) = 6/8 = 0.75

IP (C5): 251-300
P(IP=251-300 | Class: Decreased Production
(Loss)) = 1/7 = 0.1428.
P(IP=251-300 | Class: Increased Production
(Profit)) = 0/8 = 0.

BW (C6): 1.06 - 1.55.
P(BW=1.06 - 1.55 | Class: Decreased Production
(Loss)) = 7/7 = 1.
P(BW=1.06 - 1.55 | Class: Increased Production
(Profit)) = 3/8 = 0.375.

d. P(X|Ci):
P(X|Class Status = Decreased Production (Loss))
=C1+C2+C3+C4+C5+C6
= 0.14...+0.57...+0.28+0.85+0.14+1
= 3

P(X|Class Status = Increased Production (Profit))
=C1+C2+C3+C4+C5+C6
= 0.25+0.75+0+0.75+0+0.375
= 2.125

e. P(X|Ci) * P(Ci):
P(X|Class Status = Decreased Production (Loss)) * P(Class Status = Decreased Production (Loss))
= 0.4666666667 x 3 = 1.4000000002.

P(X|Class Status = Increased Production (Profit)) * P(Class Status = Increased Production (Profit))
= 0.5333333333 x 2.125
= 1.1333333333

Therefore, since the sample X in the Decreased Production (Loss) class is greater than the Increased Production (Profit) class, the predicted result is that chicken production is expected to decrease (loss).

System Implementation

The following is a step-by-step process of calculating Naive Bayes in the classification of village broiler chicken production in Nisam Subdistrict, North Aceh Regency.

Entering criteria data

The criteria data page is a form for displaying sample assessment criteria data. In this case, data

can be inputted directly as well as viewed. The appearance is as shown in Figure 3.

Source : (Research Results, 2024)
Figure 3. Entering Criteria Data Form

In the research, there are six criteria considered, each identified by a specific code: Population (C1), Age (C2), Depletion (C3), FCR (Feed Conversion Ratio) (C4), IP (Index Performance) (C5), and BW (Body Weight) (C6).

Training Data Input

The training data form is a form for displaying and inputting training data, which includes the historical production data of broiler chickens and the classification of that historical data. The appearance is as shown in Figure 4.

Source : (Research Results, 2024)
Figure 4. Training Data Form

Test Data

This form serves to add test data to the sample value setting form, including the sample code (kd_sampel) and sample name, in order to facilitate the process of inputting criteria values. The appearance is as shown in Figure 5.

Source : (Research Results, 2024)
Figure 5. Test Data Form

Page of Results Data

The results data page is a page that displays the outcomes of the naive Bayes classifier data mining process. Subsequently, this data can be used to generate reports and be printed. The appearance is shown in Figure 6.

Source : (Research Results, 2024)
Figure 6. Results Data Form

Accuracy Score

Accuracy calculations are carried out to assess the performance of the Naïve Bayes algorithm in the system (Dinata, et al., 2023).

$$acuracy = \frac{\text{number of true prediction}}{\text{number of data}} \quad \text{.................................} (1)$$

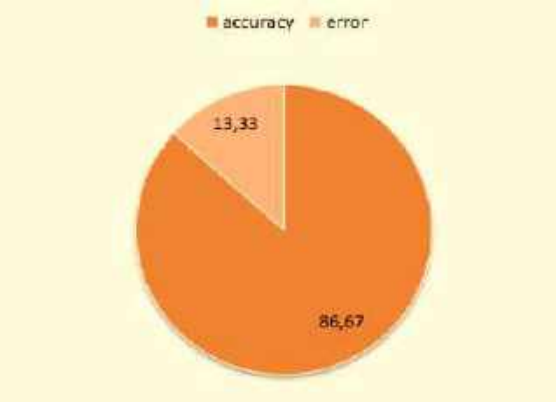
$$= \frac{13}{15} \times 100 = 86{,}67$$

$$Error = \frac{\text{number of false prediction}}{\text{number of data}} \quad \text{.................................} (2)$$

$$= \frac{2}{15} \times 100 = 13{,}33$$

In the accuracy measurement of Naive Bayes above, there were 15 data evaluated. Out of these 15 data, 13 were predicted correctly, while 2 were predicted incorrectly. Thus, the accuracy measurement of the Naive Bayes model indicates that it has an accuracy rate of 86.67%, with an error rate of 13.33%. This suggests that the Naive Bayes model tends to perform well in predicting and classifying data.

The assessment of accuracy involves determining the effectiveness of the Naïve Bayes algorithm within the system. The accuracy is calculated by dividing the number of correct predictions by the total number of data points and expressing it as a percentage. Additionally, the error rate is determined by dividing the number of incorrect predictions by the total number of data points and expressing it as a percentage as shown in Figure 7.



Source : (Research Results, 2024)

Figure 7. Accuracy Score

CONCLUSION

This research successfully addresses these challenges by introducing a predictive system utilizing the Naive Bayes Classifier algorithm. The system evaluates critical factors such as population, age, depletion, FCR (Feed Conversion Ratio), IP (Index Performance), and BW (Body Weight) to classify broiler chicken production as either increasing (profitable) or decreasing (unprofitable). Developed with the PHP programming language and utilizing a MySQL database for data storage, the system has proven its effectiveness in generating timely and insightful reports. By achieving an accuracy rate of 86.67% and an error rate of 13.3%, the Naive Bayes method demonstrates its reliability in predicting production outcomes. The implementation of this system is expected to revolutionize broiler chicken farming in the region, offering farmers valuable insights to optimize production management, enhance business profitability, and make informed decisions for sustainable growth. Ultimately, this research contributes to the advancement of agricultural practices, providing a robust foundation for future endeavors in the ever-evolving landscape of poultry farming.

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THE DEVELOPMENT OF AUTOMATIC CIGARETTE SMOKE DETECTION SYSTEM USING TA12-100 AND MQ-135 SENSORS

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Abstract— *Indonesia is ranked 3rd with the highest number of active smokers in the world after India and China. Cigarettes contain more than 4000 chemical compounds that are harmful to active smokers and passive smokers. The large number of active smokers in Indonesia also has an impact on passive smokers where passive smokers also inhale cigarette smoke. The purpose of this research is to build an automatic cigarette smoke detector to support air hygiene control, protect passive smokers, and save electricity used. The stages in designing this research include analysis of product specifications, assembly, programming, and trials. This study was designed using Arduino UNO as the microcontroller, the MQ-135 sensor as a tool to detect cigarette smoke, the TA12-100 sensor to calculate electrical power consumption, the relay as an automatic switch, and the exhaust fan as a smoke neutralizer. The results of this study are that the MQ-135 sensor can detect cigarette smoke properly with the Relay as an automatic switch that functions to turn on the exhaust fan automatically. Based on the test results on the TA12-100 sensor, the consumption of electrical energy with an automatic mechanism is more efficient than the consumption of electrical energy in a manual way, with a difference of 0.0000385 kWH and Rp. 0.05205. Future research could focus on developing a more complex system for overall air cleanliness control, rather than just focusing on cigarette smoke detection.*

Keywords: *Arduino Microcontroller, MQ-135 Censors, Smoke Detection, TA12-100 Censors,*

Intisari— *Indonesia menduduki peringkat ke 3 dengan jumlah perokok aktif terbanyak di dunia setelah India dan China. Rokok mengandung lebih dari 4000 senyawa kimia yang berbahaya bagi perokok aktif maupun perokok pasif. Banyaknya para perokok aktif di Indonesia berdampak pula pada perokok pasif dimana perokok pasif ikut menghirup asap rokok. Tujuan penelitian ini adalah membangun sebuah alat pendeteksi asap rokok otomatis guna mendukung pengendalian kebersihan udara, melindungi para perokok pasif, serta menghemat daya listrik yang digunakan. Tahapan dalam perancangan penelitian ini mencakup analisa spesifikasi produk, perakitan, pemrograman, dan uji coba. Penelitian ini dirancang dengan menggunakan Arduino UNO sebagai mikrokontrolernya, sensor MQ135 sebagai alat untuk mendeteksi asap rokok, sensor TA12-100 untuk menghitung konsumsi daya listrik, Relay sebagai saklar otomatis, dan Exhaust fan berfungsi sebagai penetralisir asap rokok. Hasil dari penelitian ini adalah sensor MQ135 dapat mendeteksi asap rokok dengan baik dengan Relay sebagai saklar otomatis berfungsi untuk menghidupkan exhaust fan secara otomatis. Berdasarkan hasil uji pada sensor TA12-100 konsumsi energi listrik dengan mekanisme otomatis lebih hemat dibandingkan dengan konsumsi energi listrik dengan cara manual dengan selisih 0.0000385 kWH dan Rp. 0,05205. Penelitian selanjutnya dapat berfokus kepada Pengembangan sistem yang lebih kompleks untuk pengendalian kebersihan udara secara keseluruhan, bukan hanya terfokus pada deteksi asap rokok.*

Kata Kunci: *Arduino Uno, Sensor MQ 135, Deteksi Asap Rokok, , Sensor TA 12-100.*

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INTRODUCTION

Smoke is a suspension of small particles in the air (aerosols) that come from incomplete fuel combustion. Smoke is generally an uncooled byproduct of fire. One example of smoke is cigarette smoke. Cigarette smoke is smoke that arises from smoking activities. Cigarette smoke has a negative impact on body health, not only for smokers (active smokers) but also for inhalers other than passive smokers (Rahmad, Ekadiansyah, Triandi, Puspasari, & Ardiyanti, 2021). The Ministry of Health released the results of a global survey on tobacco use in adults (Global Adult Tobacco Survey – GATS) which was carried out in 2011 and repeated in 2021 involving 9,156 respondents. In his findings, over the last 10 years, there has been a significant increase in the number of adult smokers by 8.8 million people, namely from 60.3 million in 2011 to 69.1 million smokers in 2021 (Widyawati, 2022). Cigarette consumption by the public is increasing rapidly, and almost everywhere we meet people who consume cigarettes. Based on data from the Central Bureau of Statistics, it is noted that the number of active smokers aged over 15 years has increased from 28.89% in 2020 to 29.33% in 2021, and East Java Province is ranked 18th in Indonesia as a region with a smoking rate quite a young age. (BPS, 2021).

Besides harming the health of active smokers, cigarette smoke is also detrimental to passive smokers. The air pollution it causes is environmental cigarette smoke or Environment Tobacco Smoke (ETS). Those who smoke ETS as passive smokers or Secondhand Smoke (SHS), passive smokers do not smoke but are forced to inhale cigarette smoke from their environment. The smoke from burning cigarettes doesn't just evaporate into the air, however, there is nicotine residue that sticks to the dust or things around us, such as clothes, carpets, walls, furniture, or chairs. This nicotine dust will not disappear in a short time so it will be inhaled by other people even though the smoker has left the place (Siregar, Simamora, & Daulay, 2021). People who do not smoke (passive smokers) will inhale twice as much poison contained in cigarette smoke. A cigarette contains harmful substances, such as nicotine, tar, arsenic, cadmium, cyanide, nitrosamines, and many other compounds that can cause various diseases such as chronic cough, lung cancer, and other health problems, approximately 4000 compounds. and 250 of them are the most dangerous and deadly (Tantri, 2021).

Considering the many harmful compounds or substances posed by cigarette smoke for passive smokers, this has an impact on passive smokers or non-smokers exposed to direct exposure to cigarette smoke which can cause various diseases such as cardiovascular, lung cancer, atherosclerosis, heart attacks, strokes, and other diseases that can be bad for passive smokers in the future (Ningrum & Indrayani, 2019). Until now the solution that has been implemented so that passive smokers avoid exposure to cigarette smoke is by installing an alarm that functions as a warning for smokers not to smoke anywhere (Umar, K., Halide, Rusjdi, & Ijsam, 2023), but the existing solution so far has not taken direct action to prevent smoking. Passive smokers avoid exposure to cigarette smoke.

In addition to written warnings regarding the prohibition of smoking in certain places, it is necessary to create a good, fast, and economical system to be able to monitor and give warnings to violators who often smoke out of place. With the existence of an automated system, it is expected to facilitate human work. Several literature reviews have been conducted to support this research. The first is research entitled Monitoring System for Cigarette Smoke Detection Equipment in Microcontroller-Based Rooms Using Mq-135 and Telegram where this research aims to create a monitoring system for cigarette smoke detectors by connecting the microcontroller with telegrams on smartphones, laptops, and computers so that monitoring range becomes wider (Sambani, Rohpandi, & Fauzi, 2021).

Furthermore, there is research entitled Making Cigarette Smoke Detectors in the Labor Environment of the Faculty of Engineering with Arduino-Based Alarms. This study aims to make a cigarette smoke detector with an Arduino-based alarm and an MQ 2 sensor as an interface for Buzzer instructions as output. The results of this study are that the system built can work properly, the MQ-2 sensor functions properly and the Buzzer can work according to orders so that with this warning alarm the room is smoke-free (Harja, 2020). The next piece of literature is research entitled Design and Build of Cigarette Smoke and Flame Detectors for Health and Fire Management Based on Arduino Uno and GSM SIM900.

This study discusses the manufacture of cigarette smoke and flame detectors which aim to send SMS messages to users when there is smoke and flames to turn on the fan immediately. The result of this research is a tool that functions to detect smoke and flames which then sends an SMS message to the user, which later the user can turn on the dc voltage fan by replying to the message (Hamdani & Handayani, 2019). Then the next literature review is research with the title Design and Build Simulation Model of Arduino-Based Automatic Cigarette Smoke Detection and Disposal Systems. This study discusses the manufacture of cigarette smoke detectors that aim to detect

cigarette smoke and neutralize it automatically using a 12V fan. The results of this study are cigarette smoke detectors that are placed in a room, then if there are people smoking the sensor will detect cigarette smoke and display cigarette smoke levels on the LCD so that it will turn on the buzzer alarm and turn on the exhaust fan as a smoke neutralizer.

Based on the test results, the system is able to work properly and optimally, the detection process has a short delay time so that the exhaust functions of the system can run synchronously in neutralizing potential hazards in the environment (Ramady, Yusuf, Mahardika, & Lestari, 2020). Last but not least, research conducted by (Suherman, Nataraj, Pratama, & Kahfi, 2023) shows that the use Internet of Things (IoT) for electricity management system has made a significant contribution to more efficient and controller electrical energy. It can be monitored directly via web or smartphone.

The purpose of this research is to build an Automatic Cigarette Smoke Detection System Using TA12-100 and MQ-135 Sensors. The MQ-135 sensor is used to detect cigarette smoke levels in the room, while the TA12-100 sensor is used to measure electricity consumption. This system is expected to provide general knowledge for the general public regarding the dangers of smoking and can help to neutralize air automatically so as to save on electricity costs.

In this research, the TA12-100 sensor is used to calculate electrical power consumption because this sensor is a current sensor that can measure the current flowing through a circuit. By measuring the current passing through the circuit, these sensors can provide data that allows power consumption calculations. In the context of research into the development of an automatic cigarette smoke detection system, the TA12-100 sensor is used to automatically monitor system power consumption. This information is important for assessing the energy efficiency of the system and comparing power consumption between automatic and manual operating modes (Antara, Suteja, Putra, & Widja, 2022).

Meanwhile, the MQ-135 sensor was used in this research to detect cigarette smoke because this sensor is a gas sensor that is sensitive to various gases, including smoke particles and various dangerous gases contained in cigarette smoke such as ammonia, benzene and carbon monoxide. The MQ-135 sensor is an economical sensor, easy to use, and provides reliable gas detection, making it suitable for detecting cigarette smoke in automatic cigarette smoke detection systems (Oktavianto & Yunanda, 2022).

MATERIALS AND METHODS

The Arduino platform, which operates on accessible hardware and software, is an open-source electronics system. With Arduino boards, various inputs can be detected, such as light on a sensor, a button being pressed, or even a message received on Twitter. These inputs can then be transformed into outputs, such as activating a motor, illuminating an LED, or publishing content online. (Arduino, 2023). For physical computing, there is a wide range of microcontrollers and platforms to choose from. Options such as Parallax Basic Stamp, Netmedia's BX-24, Phidgets, MIT's Handyboard, and many more provide comparable functionality. These tools package the intricate aspects of microcontroller programming into a user-friendly format. Arduino, like these options, streamlines the microcontroller experience, but it offers unique benefits for educators, learners, and enthusiasts.

A. Inexpensive
Arduino sheets are moderately reasonable compared to other microcontroller stages. The slightest costly adaptation of the Arduino module can be collected by hand, and indeed the pre-assembled Arduino modules fetched less than $50

B. Cross-Platform
The Arduino Software (IDE) is compatible with various operating systems, including Windows, Macintosh OSX, and Linux. Unlike most microcontroller systems, which are primarily designed for Windows, the Arduino Software (IDE) offers a wider range of options for users.

C. Open Source
The Arduino software is released as an open-source platform, allowing skilled programmers to enhance its capabilities. By utilizing C++ libraries, the language can be expanded, enabling individuals to delve into the intricacies of the underlying AVR C programming language from which Arduino derives.

D. Simple
The Arduino Software (IDE) provides a user-friendly interface that is accessible to beginners and also offers advanced users the flexibility they need. It is designed with teachers in mind, as it is based on the familiar Processing programming environment. This means that students who are already learning to program in Processing will find it easy to navigate and utilize the Arduino IDE.

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Source: (Arduino Documentation, 2022)
Figure 1. Arduino Uno

The MQ-135 sensor is a gas sensor that can detect ammonia (NH3), benzene (C6H6), carbon dioxide (CO2), sodium dioxide (NOx), sulfur hydroxide (H2S), other harmful gases and smoke. Like other gas sensors in the MQ series, this sensor has digital and analog outputs. When the gas level in the air exceeds a threshold, the digital pin goes HIGH because the analog output pin provides an analog voltage that can be used to estimate the gas level in the air. (Rombang, Setyawan, & Dewantoro, 2022). Inside the MQ-135 sensor, there is a tin dioxide (SnO2) sensing element. When the sensor comes into contact with gases, certain gas molecules are adsorbed onto the surface of the sensing element, leading to changes in its electrical resistance. These changes are then measured and analyzed to determine the presence and concentration of specific gases.

Regarding cigarette smoke detection, cigarette smoke contains various gases and particles, including carbon monoxide, volatile organic compounds (VOCs), and particulate matter. When cigarette smoke interacts with the MQ-135 sensor, it can trigger changes in the conductivity of the sensing element, allowing the sensor to detect the presence of cigarette smoke. The MQ-135 sensor's ability to detect various gases, including cigarette smoke, lies in its sensitivity to changes in the chemical composition of the surrounding environment. By calibrating the sensor and analyzing its response patterns to different gases, it can reliably identify and quantify the presence of specific gases, making it suitable for applications such as air quality monitoring, industrial safety, and environmental monitoring.

Source: (Rombang, Setyawan, & Dewantoro, 2022)
Figure 2. MQ-135 Censors

In an electronic circuit, there are voltage, current, and resistance that are interconnected. An ampere meter is a tool for measuring the current flowing in an electronic circuit. An electric current flowing in a conductor creates a magnetic field. Therefore, electric current can be measured by the magnitude of the magnetic field.

The magnetic field is influenced by several factors, including the amount of electric current, the distance of the magnetic field to a point of measurement, the direction of the magnetic field that is formed (Ardiliansyah, Puspitasari, & Arifianto, 2021). A magnetic field is a field created by moving electric charges (electric currents) which cause a force to appear on other moving electric charges. The quantum mechanical spin of a single particle forms a magnetic field and the spin is affected by itself like an electric current A magnetic field is a vector field, i.e., associated with every point in vector space which can change with time.

Current strength can be measured by connecting the device in series to the circuit conventionally. This method has a weakness because it interferes with the flow of current to be measured (Antara, Suteja, Putra, & Widja, 2022).

Source: (Antara, Suteja, Putra, & Widja, 2022)
Figure 3. TA12-100 Censors

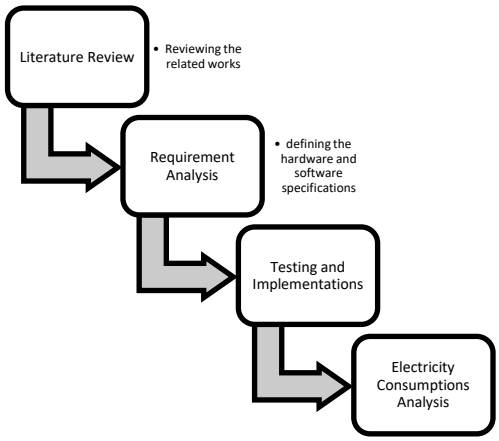
Current sensor A wire carrying an electric current to the load is passed between the toroid ring and a number of email wires are wound on the toroid ring, the wire coil on the ring will induce an electric current from the current wire. By processing the induction signal on the toroid coil wire, the value of the current that is passed to supply the load at the end of the current wire will be obtained. With this method, the current that is passed will be read on the voltage magnitude function in the form of a sinusoidal wave.

Table 1. TA12-100 Sensors Data Sheets

Items	Min	Typical	Max	Unit
Transformation Coefficient	-	1000:1	-	-
Input Current	0	-	5	A
Output Current	0	-	5	mA
Sampling Resistor	-	200	-	Ω
Sampling Voltage	0	-	1	v
Working Frequency	20	-	20000	HZ
Non-Linear Scale	-	-	0,2%	-
Phase Shift	-	-	5’	-
Operating temperature	-55	-	85	~
Dielectric Strength	-	6	-	KVAC/1min

Source: (Antara, Suteja, Putra, & Widja, 2022)

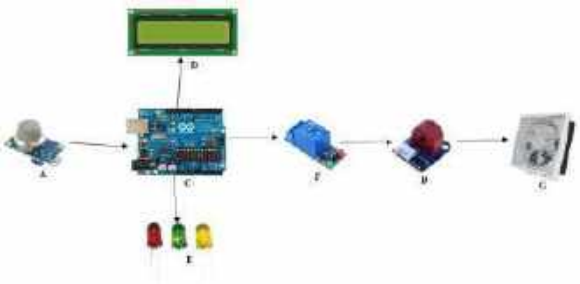
Referring to the research flow in Figure 1, this research starts from a literature review related to the cigarette smoke detection system using Arduino. Next is a needs analysis and preparation of what hardware and software is needed. The tools that have been arranged will then be implemented in a 3x3 meter room. Then the TA 12-100 sensor is used to measure the power consumption required to turn on the exhaust fan.



Source: (Aditya, Lotussa, & Putri, 2021)
Figure 4. Research Flow

After conducting a review of previous work, the next step is to analyze the requirements and define the hardware used. Referring to Figure 5, the following is a description of a series of tools for detecting cigarette smoke:

A. MQ-135 Sensors
The MQ-135 sensor functions to read the PPM (Parts Per Million) in cigarette smoke
B. TA 12-100 Sensors
Sensor TA12-100 serves to measure the voltage and use of AC power
C. Arduino Uno
Arduino Uno is a microcontroller that functions to make it easier to control electronic components with programs
D. LCD
The LCD is a tool that functions to display text from what has been read by the MQ135 sensor
E. LED
LED is an electronic component that converts electrical energy into light
F. Relay
A Relay is an automatic switch that functions to break and connect electricity
G. Exhaust Fan
The exhaust fan functions as an air neutralizer, if the sensor detects cigarette smoke, the relay will automatically turn on and turn on the exhaust fan for 5 minutes



Source: (Research Method Construction, 2024)
Figure 5. Overall System Prototype Design

The following is the specification of the hardware used in the study. Arduino Uno Atmega 328 is a basic type of microcontroller with an operating voltage of 5 V. Table 2 shows the specifications of Arduino Uno.

Table 2. Arduino Uni Atmega 328 Specifications

Components	Description
Microcontroller	Atmega328
Operating Voltage	5V
Recommended Voltage	7V - 12V
Limitation	6V – 20V
Pin Input/Output Digital	14
Analog Pin Input	6
Flow on Pin Digital	40 mA
Flow on Pin	3,3 50 mA
Flash Memory	32 KB (0,5 for bootloader)
SRAM	2 KB
EEPROM	1 KB
Clock Speed	16 MHz
Length	68,6 mm
Width	53,4 mm
Weight	25 g

Source: (Harja, 2020)

Next are the basic specifications of the MQ-135 sensor where the sensor has a better concentration of detecting cigarette smoke than other sensors. This sensor has an accuracy of 10 – 1000 PPM (Parts Per Million). Table 3 shows the specifications of the MQ-135 Sensor.

Table 3. MQ-135 Sensors Specifications

Components	Description
Detectable Substance	Ammonia, CO2, NH4, CO, Smoke
Accuracy	10 – 1000 PPM
Voltage	5V
Preheat Time	24 hours
Energy Consumption	150 mA
Length	36 mm
Width	24 mm
Height	25 mm

Source: (Rombang, Setyawan, & Dewantoro, 2022)

Furthermore, the basic specifications of the TA12-100 sensor where this sensor has a Brick-type Current Transformer TA12-100 which has better

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and more accurate measurements compared to other current sensors. This sensor has a current measurement range of 0-5 Amperes. Table 4 shows the specifications of the TA 12-100 sensor.

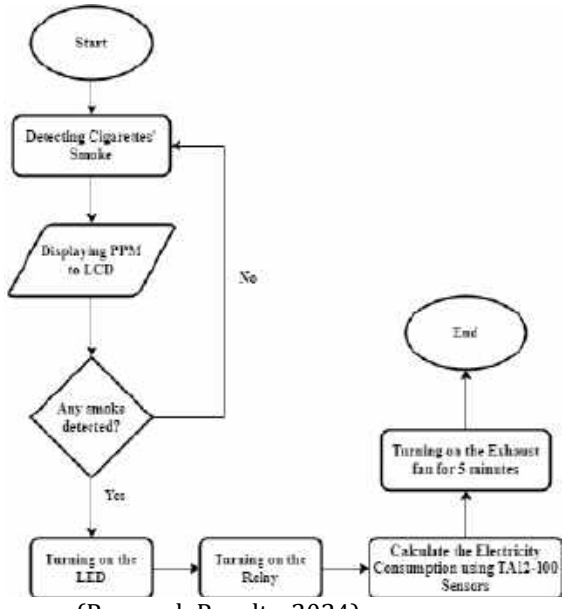
Table 4. TA12-100 Sensors Specifications

Components	Description
Type of Sensors	Brick TA12-100 Current Transformer
Current Measuring Range	0 – 5 Ampere
Voltage	5V
Frequencies	20-20000Hz
Temperature	55℃ ~+ 85℃
Modul Length	30 mm
Modul Width	24 mm
Modul Height	1,5 mm

Source: (Antara, Suteja, Putra, & Widja, 2022)

RESULTS AND DISCUSSION

The design of a cigarette smoke detection system can be seen in Figure 6. This detector will be tested in a 3x3 room. Referring to the flow of testing the tool as shown in Figure 5, the tool will be placed in the corner of the room with an exhaust fan installed. Cigarette smoke will be detected by the sensor which will then be displayed on the LCD. If cigarette smoke is detected, the LED light will turn on and then proceed with turning on the relay, then the exhaust fan will turn on for approximately 5 minutes. The fan will automatically turn off when no smoke is detected.



Source: (Research Results, 2024)

Figure 6. Flowchart of Cigarette Smoke Detection and Calculating Automatic Electrical Energy Consumption using Arduino Uno

Figure 7 is the result of the sensor assembly with the exhaust fan. The tool will be placed in a corner of the room and connected to a laptop/pc so that the configuration can be arranged in such a way. Tool testing is carried out with the range limit of the MQ135 sensor as far as 1 meter and set at 150 ppm and the TA12-100 sensor will later calculate the electricity used to turn on the exhaust fan for 5 minutes and later it can also be converted into rupiah. The MQ135 sensor reads the ppm level in the room, the room conditions are set in such a way that even if the room uses an AC (Air Conditioner) or fan, it does not affect the air quality. Furthermore, the ppm (air quality value) level is displayed on the LCD and serial monitor, if the higher the level ppm the worse the air quality in a room, so if the sensor detects more than 150 ppm it is expected that Arduino will give a signal to the relay to conduct electricity to turn on the exhaust fan which is given a tolerance of 5 minutes.

Source: (Research Results, 2024)

Figure 7. Installing Device

At this stage there are 3 tests presented, the first is testing the detection distance of the tool and the second is electricity consumption automatically and the third is testing electricity consumption manually. The first testing phase is testing to find out how far the MQ135 sensor can detect smoke. In this test, obtained data at a distance of 20-140 cm the MQ135 sensor can detect smoke well, at a distance of 160-200 cm the sensor cannot detect smoke because the smoke distance is too far so that it cannot be detected by the MQ135 sensor. Table 5 shows the results of cigarette smoke sensor testing.

Table 5. Cigarette Smoke Sensor Testing

No	Distance (Cm)	Status
1	20	Detected
2	40	Detected
3	60	Detected

No	Distance (Cm)	Status
4	80	Detected
5	100	Detected
6	120	Detected
7	140	Detected
8	160	Not Detected
9	180	Not Detected

Source: (Research Results, 2024)

The next test calculates the electricity costs incurred to manually turn on the exhaust fan. This test is to reveal how much the cost of electricity consumption is used when the exhaust fan is turned on manually without going through sensor detection. The results of this calculation will be compared with the use of the TA 12-100 sensor to turn on the exhaust fan automatically. Table 6 shows the Electric Power Consumption Using an Exhaust Fan Manually accompanied by a conversion to the IDR value.

Table 6. Consumption of Electric Power Using Exhaust Fan Manually

Time	Watt	kWH	Price (IDR)
16:13:00	33,4	0,0000278	0,03758
16:13:03	32,1	0,0005360	0,72467
16:14:00	32,1	0,0010710	1,44799
16:15:00	32,1	0,0016060	2,17131
16:16:00	32,1	0,0021410	2,89463
16:17:00	32,1	0,0026760	3,61785
16:18:00	32,1	0,0032110	4,34127
16:19:00	32,1	0,0037460	5,06459
16:20:00	32,1	0,0042810	5,78791
16:21:00	32,1	0,0048160	6,51123
16:22:00	32,1	0,0053510	7,23455
16:23:00	32,1	0,0058860	7,95787

Source: (Research Results, 2024)

The last test is measuring the electricity costs incurred to turn on the exhaust fan automatically. This test uses the TA 12-100 sensor where this sensor functions to turn on and turn off the exhaust fan based on cigarette smoke detection carried out by the MQ135 sensor. Table 7 shows the power consumption expended to turn on the exhaust fan automatically.

Table 7. Electric Power Consumption Using Exhaust Fan Automatically

Time	Power (Watt)	Power in kWH	Price (IDR)
15:41:00	34,332	0,0000281	0,03799
15:41:03	31,880	0,0005328	0,72034
15:42:00	31,880	0,0010641	1,43866
15:43:00	31,880	0,0015954	2,15698
15:44:00	31,880	0,0021267	2,87529
15:45:00	31,880	0,0026580	3,59361
15:46:00	31,880	0,0031894	4,31206
15:46:03	34,332	0,0032175	4,35006
15:47:00	31,880	0,0037222	5,03241
15:48:00	31,880	0,0042535	5,75073
15:49:00	31,880	0,0047848	6,46904
15:50:00	31,880	0,0053161	7,18736
15:51:00	31,880	0,0058475	7,90582

Source: (Research Results, 2024)

The research abstract highlights the significant issue of smoking in Indonesia, where it is ranked 3rd globally in terms of active smokers. The harmful effects of cigarette smoke, containing over 4000 chemical compounds, not only impact active smokers but also pose risks to passive smokers. The development of an automatic cigarette smoke detector aims to address air hygiene control, protect passive smokers, and promote energy efficiency.

The utilization of Arduino UNO as the microcontroller, MQ-135 sensor for smoke detection, TA12-100 sensor for power consumption calculation, relay for automatic switching, and exhaust fan for smoke neutralization showcases a comprehensive approach to designing the system. The successful detection of cigarette smoke by the MQ-135 sensor and the efficient energy consumption demonstrated by the TA12-100 sensor validate the effectiveness of the developed system.

CONCLUSION

Based on the results of the design and testing of the tool, it can be concluded that the MQ135 sensor can effectively detect cigarette smoke, which can later be used to detect cigarette smoke and neutralize the air in a room. Furthermore, the TA12-100 sensor, which functions as a counter to electrical energy consumption, can also properly calculate and compare electricity consumption when using automatic and manual methods. The test results show that the consumption of electrical energy using the TA 12-100 sensor which automates the use of exhaust fans, is more power- and cost-efficient than the manual method, with a difference of 0.0000385 kWH and Rp. 0.05205. Further research is still needed regarding the reading of the MQ135 sensor, which can be used in various rooms; therefore, there is no need to set the program code when you want to move it. Therefore, it is necessary to consider adding other components such as a DHT11 sensor so that it can detect hot air in a room.

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ANALYZING THE COMPARATIVE METHODS OF PREWITT, ROBINSON, KRISCH AND ROBERTS IN DETECTING THE EDGES OF RICE LEAVES

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Abstract— *This research explores the vital role of rice in Indonesia as a staple food and primary source of income for farmers. Efforts are being made to increase rice production to meet the growing demand. The study focuses on object edge detection in image analysis, evaluating methods like Prewitt, Robinson, Krisch, and Roberts. Digital imaging plays a crucial part in visually presenting information, and image processing improves image quality for human and machine recognition. Detecting object edges, particularly in rice leaf images, is essential for computer inspection. The experiment on fifteen rice leaf images shows that the Krisch method performs better in edge detection, with a 52% average accuracy and smoothness. Other methods, such as Prewitt (6%), Robinson (11%), and Roberts (14%), have lower accuracy rates. These findings provide a foundation for enhancing edge detection in rice leaf image analysis. The study also emphasizes the need for refining classification models. Overall, this research provides insights into the effectiveness of edge detection methods in rice leaf image analysis.*

Keywords: *Krisch And Roberts, Prewitt, Robinson, , Rice Leaves.*

Intisari— *Penelitian ini membahasa peran penting beras di Indonesia sebagai makanan pokok dan sumber pendapatan utama bagi petani. Upaya dilakukan untuk meningkatkan produksi beras guna memenuhi permintaan yang terus meningkat. Studi ini berfokus pada deteksi tepi objek dalam analisis gambar, dengan mengevaluasi metode seperti Prewitt, Robinson, Krisch, dan Roberts. Imaging digital memainkan peran penting dalam menyajikan informasi secara visual, dan pengolahan gambar meningkatkan kualitas gambar agar dapat dikenali oleh manusia dan mesin. Mendeteksi tepi objek, terutama pada gambar daun padi, sangat penting dalam pemeriksaan komputer. Eksperimen dari lima belas citra daun padi menunjukkan bahwa metode Krisch memiliki performa yang lebih baik dalam deteksi tepi, dengan akurasi rata-rata dan kehalusan mencapai 52%. Metode lain, seperti Prewitt (6%), Robinson (11%), dan Roberts (14%), memiliki tingkat akurasi yang lebih rendah. Temuan ini menjadi dasar untuk meningkatkan deteksi tepi dalam analisis gambar daun padi. Studi ini juga menekankan perlunya penyempurnaan model klasifikasi. Secara keseluruhan, penelitian ini memberikan wawasan tentang efektivitas metode deteksi tepi dalam analisis gambar daun padi.*

Kata Kunci: *Krisch dan Roberts, Prewitt, Robinson, , Daun Padi.*

INTRODUCTION

Rice as a rice-producing crop is a very important commodity for Indonesia, apart from being a staple food producer, rice is also the main source of income for millions of farmers Every year the need for rice continues to increase, to meet domestic and export needs. Various efforts have been made to increase rice production (Adianto 2020). The edge or side of an object is an area where there is a fairly high change in color intensity. The edge detection process will convert this area into two types of values, namely low or high color intensity, for example zero or one. Edge detection will produce a high value if an edge is found and a low value otherwise (Sun et al. 2022). Digital images or popularly known as images are part of multimedia which have a role in presenting information and content visually. The image is a function in dimension space, f(x, y) where x and y are spatial

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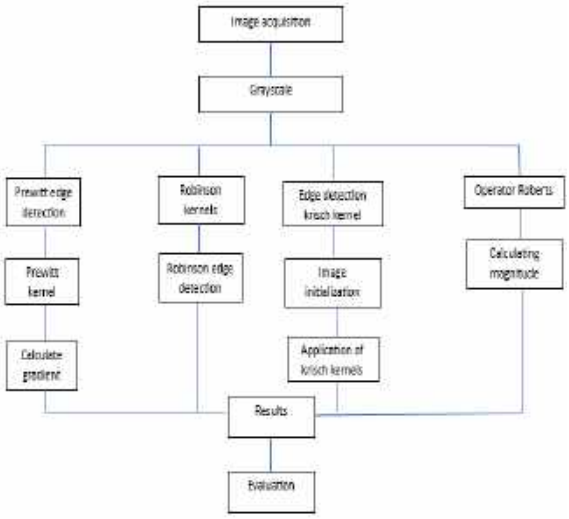
coordinates and the amplitude at certain coordinates (x, y) is called the image intensity value. Digital images can be obtained from various media or image acquisition tools with varying qualities. Each image has characteristics that are used to recognize an object. This recognition can be done through image processing, for example the image of rice leaves (Evsutin 2020). Image processing is a method for manipulating and improving image quality through various means. The main function of digital image processing is to improve image quality, so that it looks clearer and is easily recognized by humans or machines. Apart from that, image processing aims to interpret or extract image content, so as to find meaningful and significant information (Richards and Jia 2022). The edge of an object in an image can be defined as the boundary between two regions or two pixels that are close to each other and have a sharp or high difference in intensity, so that they will form the edge of the object. Detection in leaf images is an important step in computer leaf inspection (Harakannanavar et al. 2022). Edge detection is used in image analysis to be processed in object recognition using a computer. The algorithms for detecting edges analyzed are edge detection such as Prewitt, Robinson, Krisch, and Roberts. The observed experimental results show that Krisch edge detection works better than its counterpart edge detection methods(Shah et al. 2020). Iris recognition for security plays an important role in today's technological advancements. The segmentation process is carried out to group the right parts of the eye, for example. iris region, to extract the top and bottom textures, calculate the texture image, using the local entropy of the grayscale image (Mayangky 2023). Edges characterize the boundaries of an object in a digital mage and play an important role in image processing. Image edge detection reduces the data size and filters out unimportant information and preserves important structural properties of the image. Edge detection is the process of finding the boundaries of objects or textures in the image (Ranjan and Avasthi 2022). The goal of edge detection is to improve the appearance of the boundary lines of an object in the image. Therefore, it is possible to combine the level of edge line sharpness and edge detection shape accuracy into a convolution in one dimension with two different directions (vertical and horizontal) (Widiawati and Wulandari 2019).

MATERIALS AND METHODS

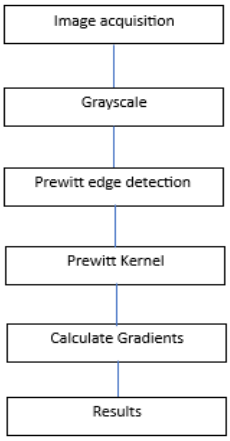
Edge Discovery is an image processing process to gain the edge boundaries of objects. The edge of an object in the image is characterized by a drastic change in the intensity value between two pixels that are close to each other. Edges can also be interpreted as a collection of pixels that are connected to each other, and are located at the boundaries between objects in the image. Edge discovery styles are divided into two orders, videlicet first- order edge discovery and alternate-order edge discovery. The first order, the edge discovery process is carried out using first order derivations or differentials, the edge discovery styles used are Prewitt, Robinson, Krisch, Roberts. Each edge discovery system uses drivers and has a different way of working, so it's necessary to experiment in certain cases. to find out the discovery system that produces the stylish object edges, by comparing the edge discovery results for the birth of four morphological features, videlicet; area, border, length and range (Makandar 2022). Can be seen in Figure 1. Edge Discovery system.



Source(Research Result, 2024)

Figure 1. Edge Detection Method

Method prewitt



Source(Ryu, 2023)

Figure 2. Prewitt method

a) Image acquisition:

Taking 15 images fromkaggle.com. By understanding image reclamation using the edge discovery system, we can explore the implicit and utility of this system in assaying illustrations and rooting features in images fluently. Then are some of the images used (Kaggle n.d.):

Source: (Research Results, 2024)
Figure 3. Rice Leaves

b) Grayscale :
Grayscale is a term used in the world of graphic computing and image processing to describe an image or picture that only has a argentine scale. In grayscale images, each pixel can be represented by a position of brilliance or argentine intensity, where these values range from 0(black) to 255(white), with values in between representing the argentine position (Viscaino et al. 2022). The following are grayscale exemplifications of several images taken:

Source: (Research Results, 2024)
Figure 4. Rice Leaves Grayscale

c) Prewitt edge detection:
Prewitt edge discovery is a system in image processing that's used to find edge lines or significant changes in pixel intensity in an image. This system uses complication operations with a Prewitt kernel, which consists of a 3x3 matrix to descry vertical and perpendicular changes in intensity (Yasir et al. 2022).

d) Kernel Prewitt :
The Prewitt kernel is generally used in matrix form with a size of 3x3. Each element in the matrix is a weight used in the complication operation to descry edges or silhouettes (Ryu 2023).

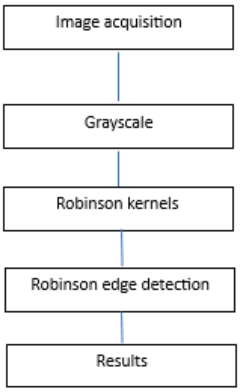
e) Calculate Gradient:
Prewitt gradient calculations are carried out by applying Prewitt kernels horizontally and vertically to the image. The horizontal gradient (Gx) and vertical gradient (Gy) are calculated using the following formula (Supriyatin 2020) :

$$Gx = \begin{bmatrix} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{bmatrix} \quad (1)$$

$$Gy = \begin{bmatrix} -1 & 0 & 1 \\ -1 & 0 & 1 \\ -1 & 0 & 1 \end{bmatrix} \quad (2)$$

$$GP = |Gx * 1| + |Gy * 1| \quad (3)$$

Methode Robinson

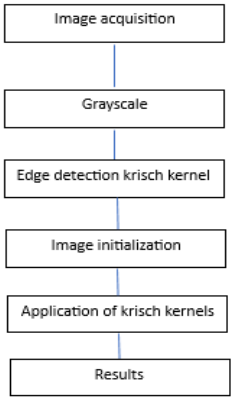


Source: (Armansyah, 2022)
Figure 5. Robinson method

f) Kernel robinson :
The Robinson kernel driver is used in image processing for edge discovery and has several kernel variants that are used for edge discovery in colorful directions. Generally, the Robinson kernel uses a 3x3 matrix like the Prewitt and Sobel kernels (Armansyah 2022).

h) Robinson edge detection:
The Robinson kernel driver is used in image processing for edge discovery and has several kernel variants that are used for edge discovery in colorful directions. Generally, the Robinson kernel uses a 3x3 matrix like the Prewitt and Sobel kernels.

Method Krisch



Source: (Shah, 2022)
Figure 6. Krisch method

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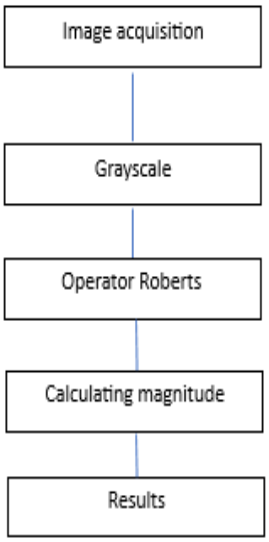
i) Edge detection kriscrnel:
The Krisch kernel, like other edge discovery drivers, is alsh keo used in complication operations to descry changes in intensity that indicate the presence of edges or silhouettes in the image. Krisch kernels generally have a size of 3x3, and correspond of weight values placed in a matrix arrangement.

j) Image initialization:
Image initialization using the Kirsch method is the first step in image processing that uses the Kirsch operator for edge detection. The Kirsch method involves the use of a Kirsch kernel that has eight different edge detection directions. This image initialization process prepares the image to then be processed with the Kirsch operator to detect edges in various orientations.

Metode Roberts



Source: (Widyawati, 2019)
Figure 7. Roberts method

j) Operator Roberts :
The Roberts operator is an edge detection method in image processing that is used to find sharp changes in pixel intensity in an image. This method uses two small kernels to detect edges diagonally.

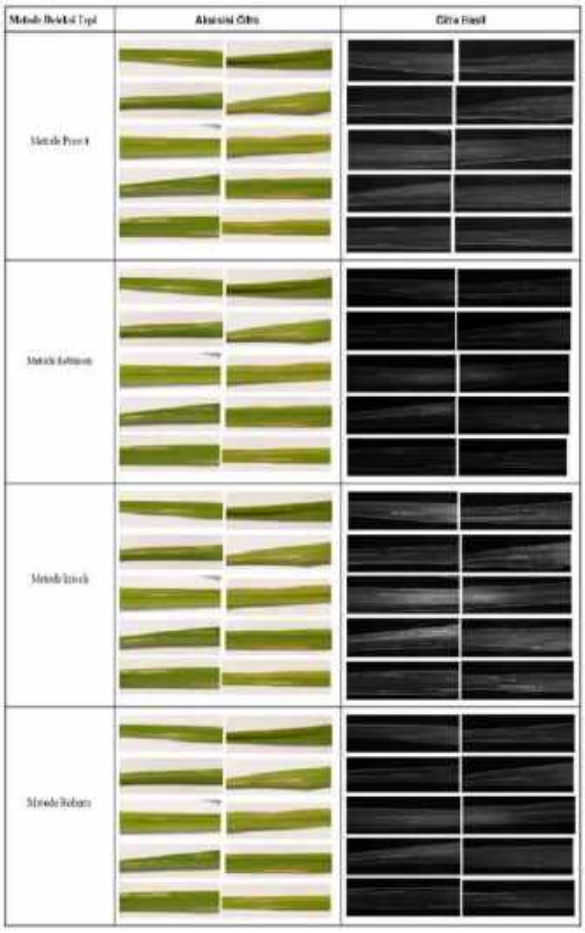
k) Calculating magnitude:
Magnitude (magnitude response) dari operator Roberts calculated by combining the results of horizontal and vertical edge detection. The following is the formula for calculating magnitude using the Roberts operator:

$$G = \sqrt{G\frac{2}{x} + G\frac{2}{y}} \quad (4)$$

Where:
- GG is the magnitude of the response,
- GxGx is the result of horizontal edge detection,
- GyGy is the result of vertical edge detection

RESULTS AND DISCUSSION

Comparison of the intensity of edge detection in rice leaf images indicates variations in the response of edge detection operators, with each operator (Prewitt, Robinson, Kirsch, and Roberts) showing unique characteristics in responding to changes in intensity at the leaf edge. This intensity comparison analysis provides sapience into each driver's capability to punctuate and depict edge structures in images, and allows the identification of certain preferences or advantages in dealing with intensity changes in these visual objects. Seen in Figure 8. Comparison of Edge Detection styles.



Source: (Research Results, 2024)
Figure 8. Comparison of Edge Detection Methods

The comparison results of edge discovery using the Prewitt, Robinson, Kirsch, and Roberts drivers show variations in edge repression and robustness to noise in colorful types of images. The Prewitt driver emphasizes perpendicular and vertical edges in rice splint images and Prewitt also tends to be effective in landing vertically or horizontally acquainted

outlines. The advantage is the simplicity of perpetration.

The Robinson driver highlights edges in eight different directions on a rice splint image. Robinson is more flexible because it can capture intensity changes in multiple directions. This can be useful if the image structure has varying exposures. The Prewitt and Robinson drivers tend to produce smoother edges.

The Kirsch driver highlights edges in eight directions like Robinson, while the Roberts driver highlights edges by emphasizing intensity changes in two slant directions. Indeed though it's simple, Roberts can give good results for slant edge discovery, the results are better applied to grayscale images than color images. still, it's lower effective at landing pure perpendicular or vertical outlines. Kirsch and Robinson drivers can also give a sharper response to depth changes in intensity.

Evaluation

These tables 1 show the performance evaluation results of an edge detection method on fifteen different images. Evaluation is carried out using Confusion Matrix and Accuracy.

Tabel 1. Evaluation of the Prewitt Edge Detection Method

Prewitt Edge Detection	Confusion Matrix	Accuracy
Image 1	[[7 4] [2593065 170581]]	6%
Image 2	[[36450 9][2599503 127695]]	6%
Image 3	[[0 0] [2697703 65954]]	2%
Image 4	[[0 0] [2617059 146598]]	5%
Image 5	[[0 0] [2472693 290964]]	11%
...	...	...
Image 13	[[37 0] [2559598 204022]]	7%
Image 14	[[0 0] [2581435 182222]]	7%
Image 15	[[64 13] [2517500 246080]]	9%

Source: (Research Results, 2024)

Each row represents information from one image, including the confusion matrix and delicacy values. All images have a low position of delicacy, with average accuracy values 6%, indicating that the bracket model used tends to be ineffective in prognosticating rightly. Refinement or improvement of the model may be necessary to ameliorate bracket performance. It can be seen in tabel 1. Evaluation of the Prewitt Edge Detection Method.

Tabel 2. Evaluation of the Robinson Edge Detection Method

Robinson Edge Detection	Confusion Matrix	Accuracy
Image 1	[[3 8] [2462464 301182]]	11%
Image 2	[[36404 55][2472176 255022]]	11%
Image 3	[[0 0] [2645046 118611]]	4%
Image 4	[[0 0] [2484656 279001]]	10%
Image 5	[[0 0] [2285189 478468]]	17%
...	...	...
Image 13	[[36 1] [2367455 396165]]	14%
Image 14	[[0 0] [2425576 338081]]	12%
Image 15	[[51 26] [2374310 389270]]	14%

Source: (Research Results, 2024)

The Robinson edge detection method applied to these images has a low level of accuracy, with average accuracy values 11%, indicating that this edge detection model is not effective in separating objects and background satisfactorily. Improvements or improvements to the detection method may be required to achieve better performance. It can be seen in tabel 2. Evaluation of the Robinson Edge Detection Method

Tabel 3. Evaluation of the Krisch Edge Detection Method

Krisch Edge Detection	Confusion Matrix	Accuracy
Image 1	[[0 11] [0 2763646]]	100%
Image 2	[[0 36459] [0 2727198]]	99%
Image 3	[[2763657]]	4%
Image 4	[[2763657]]	4%
Image 5	[[2763657]]	4%
...	...	...
Image 13	[[0 37] [0 2763620]]	100%
Image 14	[[2763657]]	4%
Image 15	[[0 169] [0 2763488]]	100%

Source: (Research Results, 2024)

The Krisch edge discovery system shows excellent performance on utmost images with a high position of delicacy, with average accuracy values 52%, The confusion matrix results give a more detailed picture of the model's performance, and in general, the model seems to have succeeded in relating edges veritably well in utmost of the images tested. It can be seen in Table 3. Evaluation of the Krisch Edge Detection Method.

Tabel 4. Evaluation of the Roberts Edge Detection Method

Roberts Edge Detection	Confusion Matrix	Accuracy
Image 1	[[11 0] [2763646 0]]	39%
Image 2	[[36459 0] [2727198 0]]	1%
Image 3	[[0 0] [2763657 0]]	0%
Image 4	[[0 0] [2763657 0]]	0%
Image 5	[[0 0] [2763657 0]]	0%
...	...	...
Image 13	[[37 0] [2763620 0]]	13%
Image 14	[[0 0] [2763657 0]]	0%
Image 15	[[77 0] [2763580 0]]	27%

Source: (Research Results, 2024)

The Roberts edge discovery model used for these images performed inadequately, with average accuracy values 14% indicated by veritably low delicacy values. This model seems to have difficulty feting edges well in all the images estimated. It can be seen in Table 4. Evaluation of the Roberts Edge Detection Method

CONCLUSION

Based on the experimental results, the Krisch method performs better in detecting edges in rice leaf images with an average accuracy of 52% and a high level of smoothness. However, the performance evaluation on fifteen rice leaf images shows low accuracy rates for other methods such as Prewitt (6%), Robinson (11%), and Roberts (14%). These findings provide a basis for improving edge detection in rice leaf image analysis. The study also emphasizes the importance of refining the classification model. Overall, this research provides insights into the effectiveness of edge detection methods in rice leaf image analysis.

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ANALYSIS OF UI & UX DRIVER MOBILE SYSTEM USING HEURISTIC EVALUATION METHOD

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Abstract— *In the 4.0 era, user interface and user experience are considered key factors in the development of digital products, especially mobile applications. The progress and performance of the application is facilitated by the user interface and user experience applied to the application. Apart from presenting an attractive application appearance, implementing a user interface and user experience for an application makes using the application easier. DMS Mobile is an information system application used by drivers which is an information system application that is easy to use for drivers to run their work activities smoothly. Testing the user interface and user experience with the user experience, in this case the driver, can be a reference for assessing the DMS Mobile application. In this user aspect approach, the researchers carried out an evaluation through a questionnaire which would be answered by respondents from PT drivers. Seino Indomobil Logistic with simple random sampling. From the research results that need to be improved, namely the criteria for User control and freedom and Flexibility and efficiency of use which still have minimal percentages. The results obtained from calculations using the heuristic method are, the age criteria of respondents aged 18 - 25 years have a percentage of 9.2% of the total respondent data, while the second is that the age of respondents is 26 - 33 years with 46.1%, and the age criteria of respondents lastly at 34 – 40 years with 44.7%.To improve it, the author used several steps, namely improving the user interface (UI), and user testing to improve the interface so that it is easier to use.*

Keywords**:** *DMS Mobile , Driver, Evaluation, Heuristic, UI, UX.*

Intisari— Di era 4.0, *user interface* dan *user experience* dianggap sebagai faktor kunci dalam perkembangan produk digital, khususnya aplikasi mobile. Progres dan performa dari aplikasi dimudahkan dengan adanya *user interface* dan *user experience* yang di terapkan pada aplikasi. Selain mempresentasikan tampilan aplikasi yang menarik, penerapan antar muka pengguna dan pengalaman pengguna untuk suatu aplikasi membuat penggunaan aplikasi menjadi lebih mudah. DMS Mobile sebagai aplikasi sistem informasi yang digunakan oleh pengemudi (driver) yang menjadi aplikasi sistem informasi yang mudah dipergunakan untuk kelancaran pengemudi dalam menjalankan aktivitas pekerjaan. Pengujian *user interface* dan *user experience* dengan pengalaman pengguna (user) dalam hal ini adalah pengemudi (driver) dapat menjadi acuan penilaian terhadap aplikasi DMS Mobile. Pendekatan aspek pengguna tersebut peneliti melakukan evaluasi melalui kuesioner yang akan dijawab oleh responden dari driver PT. Seino Indomobil Logistic dengan simple random sampling. Dari hasil yang penelitian yang perlu diperbaiki yaitu pada kriteria *User control and freedom* dan *Flexibility and efficiency of use* yang masih memiliki persentase yang minim. Hasil yang didapat dari perhitungan menggunakan metode heuristic yaitu, pada kriteria usia reponden usia 18 – 25 tahun memiliki persentase 9,2% dari keseluruhan data responden, adapun yang kedua terdapat usia responden 26 – 33 tahun dengan 46,1%, dan kriteria usia responden terakhir pada 34 – 40 tahun dengan 44,7 %. Untuk memperbaikinya penulis menggunakan beberapa langkah yaitu penyempurnaan antar muka pengguna (UI), dan user testing untuk memperbaiki antar muka sehingga lebih mudah digunakan.

Kata Kunci: Pengemudi, DMS *Mobile*, *Heuristic, , Evaluation, UI*, *UX,*

INTRODUCTION

In the current 4.0 era, (ICT) and science are experiencing very rapid developments in the ease with which we can carry out all kinds of activities (Tedd and Large 2020). Almost all organizations, companies and governments carry out activities using Information and Communication Techniques (ICT) which have gone through digitalization in every service. In the last 5 years, its use (ICT) has grown very rapidly in Indonesia. The development of indications for utilizing ICT shows the very rapid development of ICT indications (Sutarsih 2020). In its rapid development (ICT), of course it has an influence on various company sectors, as for important things that require Information and Communication Technology (ICT) with application systems with actual and structured data, one of which is PT. Seino Indomobil Logistic.

PT. Seino Indomobil Logistic is a service and services company in the logistics sector located on Jl. Lt. Gen. M.T. Haryono No. Kav. 8, RW.6, Kp. Malayu, District. Jatinegara, East Jakarta City which continues to develop in the era of digitalization 4.0. The use of information system applications is an important role in carrying out service and service activities in the current era. This application can also be accessed by every registered driver according to the NIK they already have. The application is Driver Management System (DMS Mobile)

DMS Mobile is an information system application used by drivers which must be an information system application that is easy to use and effective for drivers to carry out their work activities smoothly and has informative value (Hartawan 2021). Testing the user interface and user experience with user experience, in this case the driver, can be a reference for assessing the DMS Mobile application. A user interface and user experience that are rated as good will also establish a good correlation between the user and the information system application that is created (Wijaya et al. 2021). Apart from that, the user interface (UI) and user experience (UX) also focus on the user and the user's response to the system can be seen from their emotions, behavior and the value they get from interacting with the system If the user is uncomfortable and has difficulty using an information system application, it can be said that the DMS Mobile information system application has the potential to fail. The user aspect approach can be used in analyzing (UI) and (UX) in the DMS Mobile application (Rahmawan and Krisnanik 2023).

In its application (Wasiati and Sudarmanto 2022), there are 10 principles of Heuristic Evaluation which are usually used as guidelines when examining user needs with standard interfaces, namely, Visibility of system status, Match between system and the real world, User control and freedom, Consistency and standards, Error prevention, Recognition rather than recall, Flexibility and efficiency of use, Aesthetic and minimalist design, Help users recognize, diagnose, and recover from errors and Help and documentation which will later be selected as the basic requirements of the analysis process whether the interface is in accordance with existing principles (Adinegoro, Aziza, and Mufhadhal 2022). Furthermore, to find out more about the problems with this application, usability was carried out by filling out a questionnaire with predetermined respondents. Respondents will answer by choosing between 0 - 1.0 points (bad - excellent) which indicates whether the usability level is good or not. In this research the Heuristic Evaluation method is used to analyze the user interface. So it is hoped that the results obtained from UI/UX analysis will be more focused and specific with related methods and will be able to determine the success of UI/UX (Fitriana, Yanto, and Budiman 2020) .

Based on the description above, researchers conducted research related to Analysis (UI) and (UX) of the DMS Mobile Application using the Heuristic Evaluation method at PT. Seino Indomobil is informative and effective in carrying out work processes.

MATERIALS AND METHODS

The object of this research is the measurement of the UI and UX of the DMS Mobile Application based on the method, namely Heuristic Evaluation at PT. Seino Indomobil Logistics. There are 10 test instruments which are the main components of The testing process is heuristic evaluation, namely :

1. *Visibility of System Status*: emphasizes the importance of providing clear and understandable information to users regarding the system status and activities being carried out.
2. *Match Between System and The Real World*: is a tool to assess whether the application uses language that includes words, phrases and concepts that are close to the user.

3. *User Control and Fredoom*: is a means to assess whether the user can freely use the application, for example no processes are imposed on the user and can be canceled and repeated.

4. *Consistency and Standards*: is a tool to assess whether users do not encounter words and icons with confusing meanings when using the application, which causes user errors.

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5. *Error Prevention*: is a tool used to evaluate how well an application can handle or prevent user errors

6. *Recognition Rather Then recall*: is a tool that helps determine whether the software can minimize the user's memory of the meaning of an image, description, or option.

7. *Flexibility and Efficiency of Use*: this is a tool to increase knowledge of whether the software can speed up work and if there are shortcuts in the process.

8. *Aesthetic and Minimalist Design*: is a tool to see whether the application being created has parts of the menu, information and parts that are not very important for the user's needs.

9. *Help Users Recognize, Diagnose and Recover from Errors*: this testing tool aims to see whether the application can display error messages and provide information to resolve them.

10. *Help and Documentation*: to increase knowledge about whether the software can be used, you don't have to read the user manual and find information easily.

Data collection is a systematic and strategic step whose aim is to obtain the data needed. Data collection techniques are a process in research and are an important part (Andrean Ilham Nur Yahya 2022). Research is best done with data. There is a connection between the data collection method and the research question to be solved. The problem is directional and can affect how data is collected. Data collection as a sample was carried out using several methods (Resa and Wardani 2022).

According to (PILENDIA 2020), interviews are a technique for collecting data by asking several questions related to research to predetermined sources. Interviews in this research were conducted to obtain information and data needed to analyze the DMS Mobile application. Based on the results of the interviews conducted, the author obtained information related to:

1. A more detailed description of the problems faced by DMS Mobile application users

2. Workflow process from the DMS Mobile application

3. Information about problems encountered during the development process related to the UI and UX of the DMS Mobile Application itself.

Interviews in this research were carried out by meeting directly with respondents, where the respondents were drivers or logistics drivers who used this application, by providing questionnaire material to be filled in directly to obtain the necessary information and data (Tristiyanto et al. 2020). For this research, respondents were focused on logistics drivers based on the type of random sampling technique from the drivers that the author found in their room, with a total of 100 respondents (Subhan and Indriyanti 2021).

In this research, the questions given to (respondents) refer to 10 instruments contained in the Heuristic Evaluation method including Visibility of system status, Match between system and the real world, User control and freedom, Consistency and standards, Error prevention, Recognition rather than recall, Flexibility and efficiency of use, Aesthetic and minimalist design, Help users recognize, diagnose, and recover from errors, Help and documentation. The aim of this research questionnaire is to increase knowledge of the assessment of the DMS Mobile application currently running.

A questionnaire is a series of question instruments which are arranged based on the research variable measuring instruments, collecting data using a questionnaire properly, the respondent only chooses the answers that are already available (Sugiyono 2020). For this research, respondents were selected based on the type of sampling technique (sampling technique). The questionnaire was carried out online using media to obtain responses from respondents. The aim of this research is to increase knowledge of the current value of the DMS Mobile application and identify user needs to be used as recommendations for future DMS Mobile application developers (Zibaei and Mesgari 2023).

Data analysis is data that has been processed so that the results obtained are easy for readers to understand (Sutarsih 2020). Data analysis was carried out using data collection techniques. The results of the evaluation of problems or errors found by the evaluator are grouped according to the heuristic evaluation problem. The results are managed using a statistical analysis method using percentages, to find the heuristic evaluation score of the largest or highest problem.

RESULTS AND DISCUSSION

The response from DMS Mobile Application users is that the application is considered to be sufficient in providing clear information on various menus and features, where clear information regarding the use of the application itself is very important for users in carrying out activities in the application.

Criteria for Visibility of system status

Visibility of System Status refers to how well the system provides feedback to the user about what is

happening, the status of ongoing processes, and the overall condition of the system.

In table 1 with the Visibility of system status criteria with 3 specific questions and 76 respondents above, it is obtained that the application must always provide information to the user about what is happening, through responding well within a reasonable time.

Table 1. *Criteria for Visibility of system status*

No	Criteria	Total Score	Percentage
Q1	Visibility of	294	77,4
Q2	System	293	77,1
Q3	status (H1)	307	80,8
	Total Criteria		78,4 Good

Source : (Research Result, 2024)

Criteria match between system and the fact

Match between system and the fact is the match between the system and the fact, referring to the extent of the system or user interface (UI). The goal is to make the system more intuitive and easy for users to understand in their daily use of the system.

Based on the criteria for match between system and the real world with 3 specific questions and 76 respondents above, it was found that the application must have a match between the system and the real world. The application must be able to speak the user's language, with words and concepts that are familiar to the user rather than using application terms with table 2.

Table 2. *Criteria match*

No	Criteria	Total Score	Percentage
Q4	Match between	324	85,26
Q5	system and	344	90,53
Q6	the real world (H2)	350	92,11
	Total Criteria		89,30 Very Good

Source : (Research Result, 2024)

Criteria User Control and Freedom

User Control and Freedom are user interface design principles that emphasize the importance of giving users full power to control and manage their experience when using a product or service.

Based on the user control and freedom criteria with 3 specific questions and 76 respondents above, it was found that the application has an "Emergency Exit" option when the user selects the wrong function accidentally and leaves it in an undesirable condition without having to go through a long dialogue in table 3.

Table 3. *Criteria User Control and Freedom*

No	Criteria	Total Score	Percentage
Q7	User	182	47,89
Q8	control and	156	41,05
Q9	freedom (H3)	182	47,89
	Total Criteria		45,61 Enough

Source : (Research Result, 2024)

Consistency and standards criteria

Consistency and standards criteria refer to user interface design principles that emphasize the importance of consistency in design elements and the use of industry standards. These criteria help ensure that users have experience using the application.

In the consistency and standard criteria with 3 specific questions and 76 respondents above, it was found that users do not have to think whether words, situations and actions that are not the same actually have the same meaning. The standard is closely related to the user's ability to carry out activities with table 4.

Table 4. *Consistency and standards criteria*

No	Criteria	Total Score	Percentage
Q10	Cosistency	296	77,89
Q11	and	311	81,84
Q12	stadndards (H4)	311	81,84
	Total Criteria		80,53 Very Good

Source : (Research Result, 2024)

Error Prevention Criteria

Error Prevention Criteria is a user interface design principle that aims to reduce the possibility of errors by users when using a product or service.

Based on the error prevention criteria with 3 specific questions and 76 respondents above, it was found that the application was designed to overcome user errors in using the application by using the confirmation option in table 5.

Table 5. *Error Prevention Criteria*

No	Criteria	Total Score	Percentage
Q13	Error	269	70,79
Q14	Preventioncriteria	336	88,42
Q15	(H5)	324	85,26
	Total Criteria		81,49 Very Good

Source : (Research Result, 2024)

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Recognition rather than recall criteria

Recognition rather than recall criterion is a user interface design principle that emphasizes the importance of providing instructions or information that is easily recognized or accessed by users.

Based on the recognition rather than recall criteria with 3 specific questions and 76 respondents above, it was found that the application had a clear choice. Each action clearly makes it easier for users to use the application in table 6.

Table 6. *Recognition rather than recall criteria*

No	Criteria	Total Score	Percentage
Q16	Recognisi rather than recall (H6)	270	71,05
Q17		268	70,53
Q18		274	72,11
	Total Criteria		71,23 Good

Source : (Research Result, 2024)

Flexibility and efficiency of use criteria

Flexibility and efficiency of use criteria user interface design principles that aim to provide users with the ability to use a product or service in a way that suits their needs and level of experience.

Based on the flexibility and efficiency of user criteria, specifically with the 3 questions and 76 respondents above, it was found that users must be made easier to carry out their activities more quickly in table 7.

Table 7. *Flexibility and efficiency of use criteria*

No	Criteria	Total Score	Percentage
Q19	Flexibility and efficiency of use (H7)	161	42,37
Q20		128	33,68
Q21		150	39,47
	Total Criteria		38,51 Not Good

Source : (Research Result, 2024)

Aesthetic and minimalist design criteria

Aesthetic and minimalist design criteria are user interface design principles that emphasize the importance of creating an interface that is visually attractive but remains simple.

In the aesthetic and minimalist design criteria with 3 specific questions and 76 respondents above, it was found that the DMS Mobile application has a good appearance and layout in table 8.

Table 8. *Aesthetic and minimalist design criteria*

No	Criteria	Total Score	Percentage
Q22	Aesthetica and minimalist (H8)	307	80,79
Q23		335	88,16
Q24		337	88,68
	Total Criteria		85,88 Very Good

Source : (Research Result, 2024)

Criteria Help users recognize, diagnose, and recover from errors

Criteria Help users recognize, diagnose, and recover from errors (help users recognize, diagnose, and recover from errors) is a user interface design principle that aims to help users overcome errors that occur.

In the criteria of help users recognize, diagnose and recover from errors with 3 specific questions and 76 respondents above, it was found that if an error occurs, the wrong message must be explained in clear language, explaining the problem and providing a solution in table 9.

Table 9. *Criteria Help users*

No	Criteria	Total Score	Percentage
Q25	Help users recognize and recover (H9)	302	79,47
Q26		303	79,74
Q27		229	78,68
	Total Criteria		79,30 Good

Source : (Research Result, 2024)

Criteria Help and documentation

Help and documentation criteria are user interface design principles that aim to provide sufficient help and easily accessible documentation for users.

In the help and documentation criteria with 3 specific questions and 76 respondents above, it was found that in the application there is help and documentation available which contains information about how to use the application in table 10.

Table 10. *Criteria Help and documentation*

No	Criteria	Total Score	Percentage
Q28	Flexibility and efficiency of use (H7)	331	87,11
Q29		353	92,89
Q30		351	92,37

No	Criteria	Total Score	Percentage
	Total Criteria		90,79 Very Good

Source : (Research Result, 2024)

CONCLUSION

In this research, improvements to the UI and UX of the DMS Mobile PT application were carried out. Seino Indomobil Logistic using the heuristic evaluation method. There are points that become conclusions in this research, namely: In the Visibility of system status category, the percentage was 78.4%, the Match between system and the real world category was 89.30%, the User control and freedom category was 45.61%, the Consistency and standards category was 80.53%, the Error prevention category got a percentage of 81.49%, the Recognition rather than recall category got a percentage of 71.23%, the Flexibility and efficiency of use category got a percentage of 38.51%, the Aesthetic and minimalist category got a percentage of 85.88%, the Help users category recognize, diagnose, and recover from errors got a percentage of 79.30%, and the Help and documentation category got a percentage of 90.79%

The User control and freedom category got a percentage of 45.61% and the Flexibility and efficiency of use category got a percentage of 38.51%, which was obtained from PT's IT Helpdesk division. Seino Indomobil Logistic requires efforts to add a data correction/update feature in the order section when carrying out loading and unloading photos, adding this feature so that users can make corrections/updates if the user makes data input errors or mistakes when carrying out loading and unloading photos. Optimizing applications for development parties so that users are more comfortable using applications on various versions of Android.From all respondents who rated it, it can be concluded that the assessment criteria for the DMS Mobile application using the heuristic evaluation method were considered good. However, there are several things that still need to be improved, namely the criteria of User control and freedom and Flexibility and efficiency of us. And next, to increase the User control and freedom category, the author will add the Customization Options menu, Undo and Redo Functionality, Flexible Navigation Mode, Preference Saving, Clear Feedback, Documentation and Help Resources and Shortcuts and Quick Actions. For flexibility and efficiency of use, you will also add a Customizable Interface menu, Keyboard Shortcuts, Contextual Help and Guidance, Predictive Features, Efficient Navigation, and Quick Access.

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ANALYSIS OF THE QUALITY OF THE ZETA SCARVES WEBSITE USING THE WEBQUAL 4.0 METHOD

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Abstract—*This research aims to analyze the quality of the Zeta Scarves website using the WebQual method. The study focuses on three dimensions of website quality: usability, information quality, and service interaction. The data were collected through an online questionnaire distributed to users of the Zeta Scarves website. A total of 296 respondents participated in the study. The collected data were analyzed using descriptive statistics and the WebQual index. The results showed that the Zeta Scarves website received high scores in all dimensions of website quality. The usability dimension, which measures the ease of use and navigation, received a score of 4. The information quality dimension, which assesses the accuracy and relevance of the provided information, received a score of 3,9. The service interaction dimension, which evaluates the customer service and interaction features, received a score of 3,9. Based on the analysis, it can be concluded that the Zeta Scarves website has achieved a high level of quality, as perceived by the users. The findings of this study provide valuable insights for Zeta Scarves in enhancing their website to further improve customer satisfaction and strengthen their competitive position in the online fashion industry*

Keywords: *Customer satisfaction, information quality, service interaction, website quality, WebQual, usability.*

Intisari—*Penelitian ini bertujuan untuk menganalisis kualitas website Zeta Scarves dengan menggunakan metode WebQual. Studi ini fokus pada tiga dimensi kualitas website, yaitu kegunaan (usability), kualitas informasi (information quality), dan interaksi layanan (service interaction). Data penelitian dikumpulkan melalui kuesioner online yang disebar kepada pengguna dan calon pengguna website Zeta Scarves. Sebanyak 296 responden berpartisipasi dalam penelitian ini. Data yang terkumpul dianalisis menggunakan statistik deskriptif dan indeks WebQual. Hasil penelitian menunjukkan bahwa website Zeta Scarves mendapatkan skor High dalam semua dimensi kualitas website. Dimensi kegunaan, yang mengukur kemudahan penggunaan dan navigasi, mendapatkan skor 4, Dimensi kualitas informasi, yang menilai keakuratan dan relevansi informasi yang disediakan, mendapatkan skor 3,9. Dimensi interaksi layanan, yang mengevaluasi pelayanan pelanggan dan fitur interaksi, mendapatkan skor 3,9. Berdasarkan analisis, dapat disimpulkan bahwa website Zeta Scarves telah mencapai tingkat kualitas yang High, sebagaimana yang dirasakan oleh para pengguna. Temuan penelitian ini memberikan wawasan berharga bagi Zeta Scarves dalam meningkatkan website mereka untuk lebih meningkatkan kepuasan pelanggan dan memperkuat posisi persaingan mereka dalam industri fashion online.*

Kata Kunci: *Kepuasan pelanggan, kualitas informasi, interaksi layanan, kualitas website, WebQual, kegunaan.*

INTRODUCTION

Current technological developments are so rapid that they have a lot of influence on our lives, one of which is the internet sector, where by using the internet we can make all the activities we do easier, from working, studying, to shopping. Basically, some people will use website services to find quick and easy access to information. If the opened website service meets the current perceived quality of information services and the expected level in the future, the user will be satisfied (DS & Sanjaya, 2021). Having a website in the current era of information and technology is a process that

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encourages society to be more advanced and act effectively and efficiently in the face of very competitive competition (Diana & Sutabri, 2023). Previously, shopping was done by going to the shop or offline, but now with the internet shopping can be done without having to go to the shop directly but online via a website or sales application. Using a website allows companies to create their own virtual marketplace where their customers can order their products and services without having to go directly to a real-world point of sale (Rohi, 2016).

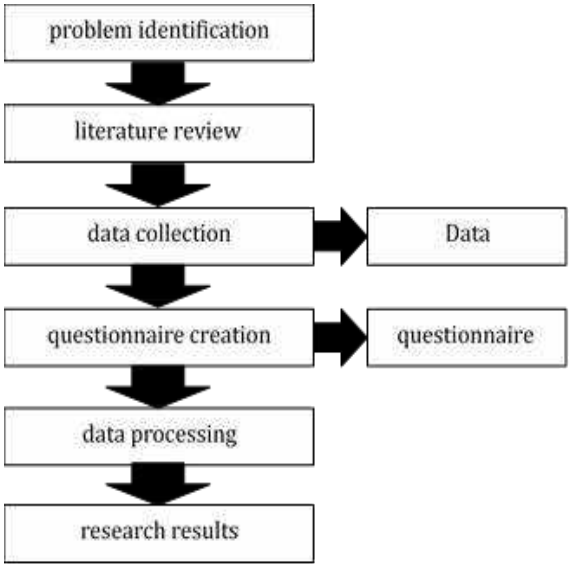
Zeta Scarves is a brand originating from a hijab shop called Zeta Scarves Lifestyle in Jakarta which sells various kinds of accessories for the hijab, Zeta Scarves has several methods of purchasing, apart from being able to buy offline Zeta Scarves can also be purchased online from WA and a website to make it easier for customers to buy products online. Because Zeta Scarves believes that besides information technology brands, such as websites, are very useful for marketing their products to places that are difficult to reach. The availability of information and services is important to increase trust, because before deciding to buy a product, customers will first look for information related to the product.

Based on these problems, it is necessary to assess the quality of the zeta scarves website using the Webqual 4.0 method. The webqual method was chosen because it focuses on assessing the quality of websites, by looking at the perceptions or views of end users (Liani, Fikry, & J. Hutajulu, 2020). Quality evaluation is needed to measure the effectiveness of website performance so that it can be developed and improved and become a reference for developers in creating quality websites (Yunianto, Purnomo, & Prasetyo, 2021)

Webqual is a method of measuring website quality based on end user perceptions (Habiba & Wijaya, 2022). This method is an extension of Servqual which has been used widely in measuring service quality (Purwandani & Syamsiah, 2021). This method is the result of the development of ServQual, a method that has been used by many experts previously in measuring service quality (Sari, 2022)

MATERIALS AND METHODS

In this section, materials and methods will be discussed with research stages divided into 6 steps, namely problem identification, literature review, data collection, questionnaire creation, data processing and research results.



Source : (Research Results, 2024)

Figure 1. The Research Workflow

The following each step in this research are explained in points A to F

A. Problem identification

Identify problems by reviewing the Zeta Scarves website and the problems found on the Zeta Scarves website

B. Literature Review

Literature study is needed to obtain basic information regarding theories relevant to the proposed research, as well as literature that has been carried out previously in similar fields and produce a research program framework

C. Data Collection

The data collection process is a very crucial stage in research, considering that the main aim is to obtain the necessary data. There are several data collection techniques used in this research, including:

1. Observation, The word observe is given the meaning, namely as observing what you want to examine (Hartono, 2018). this research was carried out by observing or observing directly at the research location, namely at PT. Zeta Eka Tunas Adhika from 15 May 2023 – 16 June 2023. This was done to obtain data that is relevant to this research
2. Interview, One of the first techniques used In collecting data it is called an interview (Fadhallah, 2021). this research uses direct interviews with HRD from the company PT. Zeta Eka Tunas Adhika to collect valid data. From this interview, the researcher obtained information about the number of visitors to the Zeta Scarves website in the period March 2022 - March 2023,

totaling 1,135 visitors, which will later be used as a population figure by the researcher.

3. Questionnaire, The data collection method which is carried out by giving written questions to respondents is the definition of a questionnaire (Herlina, 2019). data collection is carried out by giving a list of questions or written statements to respondents to answer

D. Questionnaire Creation

Making the questionnaire is based on the existing questionnaire in the WebQual 4.0 method, which consists of four variables with a total of 26 question dimensions.

Table 1. Webqual Dimensions

Dimensions	Description	Code
usability	The site is easy to learn and operate	US1
	interaction with the website is clear and easy to understand	US2
	easy to find menus on the website	US3
	the website is easy to use	US4
	has an attractive website appearance	US5
	website design that suits the type of website	US6
	the website has competence	US7
	The website creates a positive experience for users	US8
Information Quality	The website provides accurate information	IQ1
	The website provides reliable information	IQ2
	The website provides timely information	IQ3
	The website provides relevant information	IQ4
	The website provides information that is easy to understand	IQ5
	The website provides information with precise details	IQ6
	The website information in the right format	IQ7
Service interaction	The website has a good reputation	SI1
	feel safe in interacting	SI2
	feel safe with user personal data	SI3
	creating a sense of personal or guaranteed privacy	SI4
	can easily communicate with the company	SI5
	convey a sense of community or sociability	SI6
	deliver products or services as promised	SI7
User Statisfaction	I am satisfied with the quality of service	KP1
	I am satisfied with the products offered	KP2
	I will often use this website when shopping online	KP3
	I am willing to recommend this website to friends and relatives for online shopping	KP4

(Aminoto & Agustina, 2020)

To obtain samples, the Slovin formula is used as in equation 1 (Riyanto & Hatmawan, 2020)

$$n = \frac{N}{1+Ne^2} \quad \text{..... (1)}$$

n = number of samples
N = number of population
e = The maximum error margin that can be tolerated in this study is 5% or 0.05

Based on an existing population of 1,135 visitors to the Zeta Scarves website in March 2022 – March 2023, the results obtained from the slovin t echnique are as follows

$$n = \frac{1135}{1 + 1135(0.05)^2}$$

= 296 people

Based on the Slovin formula above, the sample used was 296 people with a margin of error of 5% and a confidence level of 95%.

The results of the data analysis below illustrate the percentage of respondents based on age group as seen in the following table 2:

Table 2. respondents by age

Age	Amount	Percentage
20-25 years	264	89.2%
26-31 years	25	8.4%
> 31 years	7	2.4%
Total	296	100.0%

Source: (Research Results, 2024)

Based on data analysis, there are percentages of respondents divided by gender as seen in the following table 3.

Table 3. respondents by gender

Jenis Kelamin	Jumlah	Persentase
laki-laki	108	36.5%
perempuan	188	63.5%
Total	296	100.0%

Source: (Research Results, 2024)

E. Data Processing

After the data has been collected, the data will be managed in a structured and detailed manner.

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Data management is an activity carried out after all data from respondents has been collected. Activities in data management include:

a. Validity Test

Validity refers to the extent to which the data collected in a questionnaire can measure the construct you want to measure (Monalisa, 2021). Validity in this study was evaluated by correlating the score on each item with the total score

b. Reliability Test

reliability indicates the level of reliability or consistency of the measurement instrument. Reliability tests are carried out to determine whether the instrument provides consistent measurement results at different times.

c. Classic assumption test

1) Normality Test
Aims to check whether the residual value has a normal distribution or not. A good regression model is one that has residual values that are normally distributed

2) Multicollinearity Test
used to evaluate the existence of correlation between independent variables in the regression model. The purpose of this test is to ensure that there is not a high correlation between the independent variables in a good regression model

3) Heteroscedasticity Test
Used to check whether there is a deviation from the classic assumption of heteroscedasticity, which indicates inequality of residual variance across all observations in the regression model used in this research.

d. F Test

The F test is carried out by comparing the calculated F value with the table F value. Where if the sig value is F table then there is a simultaneous influence of variable

e. T Test

The T test (T-test) is a statistical method used to compare two samples or populations in terms of average or mean. The T test is generally used to test differences between two groups, such as the difference between the control group and the experimental group in an experiment

RESULTS AND DISCUSSION

This section discusses the results of calculations from the research that has been carried out.

A. Validity Test Results

This validation test was carried out using correlation techniques. This means that by considering the value of the r-calculation relationship, the value of this relationship is compared using an r-table, where a measuring instrument is said to be valid if the r-calculation relationship (correlation coefficient) > r-table (critical table value). In this study, with a sample size of 296 (N = 296) and a significance of 0.05, an r-table value of 0.113647 was obtained. The following is a validity analysis relationship table based on each variable:

1. Dimensions of usability

Table 4. Usability Validity Test Results

question	rHitung	rTabel	Status
1	0,759949054	0,113647	valid
2	0,77040679	0,113647	valid
3	0,733876967	0,113647	valid
4	0,717024051	0,113647	valid
5	0,735709672	0,113647	valid
6	0,724453613	0,113647	valid
7	0,714177028	0,113647	valid
8	0,700165907	0,113647	valid

Source: (Research Results, 2024)

The following is a correlation table 4. and the results of the validity analysis of each measuring instrument, it is found that the correlation between each question item and its score has a high correlation, because above the r-table value, namely (US1) 0.760 > 0.113, (US2) 0.770 > 0.113, (US3) 0.734 > 0.113, (US4) 0.717 > 0.113, (US5) 0.736 > 0.113, (US6) 0.724 > 0.113, (US7) 0.714 > 0.113, and (US8) 0.700 > 0.113. So it can be concluded that all questions for the Usability (US) variable can be considered valid

2. Dimensions of information quality

Table 5. Information quality Test Results

question	rHitung	rTabel	Status
9	0,737925416	0,113647	valid
10	0,761719004	0,113647	valid
11	0,781850708	0,113647	valid
12	0,76963082	0,113647	valid
13	0,74553335	0,113647	valid
14	0,758328821	0,113647	valid
15	0,736115012	0,113647	valid

Source: (Research Results, 2024)

From table 5 the correlation results of the Information Quality Variable, it can be seen that the correlation between each question item and its score has a high correlation, because the above r-table values are (IQ1) 0.738 > 0.113, (IQ2) 0.762 > 0.113, (IQ3) 0.782 > 0.113, (IQ4) 0.770 > 0.113, (IQ5) 0.746 > 0.113, (IQ6) 0.758 > 0.113, and (IQ7) 0.736 > 0.113. Thus, all questions for the Information Quality variable can be considered valid

3. Dimensions of quality interaction

Table 6. Information Quality Interaction Test Results

question	rHitung	rTabel	Status
16	0,707893625	0,113647	valid
17	0,774046077	0,113647	valid
18	0,796180847	0,113647	valid
19	0,792822576	0,113647	valid
20	0,728775484	0,113647	valid
21	0,77674881	0,113647	valid
22	0,737324118	0,113647	valid

Source: (Research Results, 2024)

From table 6 the correlation results for the Interaction Quality variable are that the correlation between each question item and its score has a high correlation, because above the r-table value, namely (SI1) 0.708 > 0.113, (SI2) 0.774 > 0.113, (SI3) 0.796 > 0.113, (SI4) 0.793 > 0.113, (SI5) 0.729 > 0.113, (SI6) 0.777 > 0.113, and (SI7), and 0.737 > 0.113 Therefore, all questions for the Quality of Interaction (SI) variable can be considered valid

4. Dimensions of user satisfaction

Table 7. user satisfaction test results

question	rHitung	rTabel	Status
23	0.715482468	0.113647	valid
24	0.668740549	0.113647	valid
25	0.606432001	0.113647	valid
26	0.705159131	0.113647	valid

Source: (Research Results, 2024)

From table 7 the correlation results of the Information Quality Variable, it can be seen that the correlation between each question item and its score has a high correlation, because above the r-table value, namely (KP1) 0.715 > 0.113, (KP2) 0.668 > 0.113, (KP3) 0.606 > 0.113, and (KP4) 0.705 > 0.113. Thus, all questions for the Information Quality variable can be considered valid

B. Reliability Test Results

Table 8. reliability test results

Cronbach's Alpha	N of Items
.889	4

Source: (Research Results, 2024)

To assess the reliability of the questionnaire, it was tested using a reliability test with a Cronbach's Alpha score > 0.7. In a total of 26 questions, the researcher obtained an alpha value of 0.889, meaning that the data has very good/reliable reliability.

C. Classic Assumption Test Results

1. Normality Test

The normality test in this research uses the One Sample Kolmogorov Smirnov graph with the criterion that if the significance value is > 0.05 then the data used in the research has a normal distribution. However, on the contrary, if the significance value is <0.05 then the data used does not have a normal distribution

Table 9. normality test results

		Unstandardized Residual
N		296
Normal Parameters [a,b]	Mean	.0000000
	Std. Deviation	.82742986
Most Extreme Differences	Absolute	.060
	Positive	.060
	Negative	-.056
Test Statistic		.060
Asymp Sig. (2-tailed)		.011
Excat Sig. (2-failed)		.223
Point Probability		.000

Source: (Research Results, 2024)

From table 9 the results of the graph above, using the Asymp calculation, you can get a significance value of <0.05, namely 0.011, so the data used in the research does not have a normal distribution. But after testing using Exact calculations the data obtained was > 0.05, namely 0.223, which means the data is normally distributed.

2. Multicollinearity Test

Testing whether multicollinearity occurs or not is carried out by looking at the Variance Inflation Factor (VIF) value as seen in the VIF value < 10, meaning that all independent variables do not experience multicollinearity.

Table 10. multicollinearity test results

Model	Unstandardized B	Coefficients Std. Error	Standardized Coefficients Beta	T	Sig	Collinearity Tolerance	Statistics VIF
(constatn)	2.527	.433		5.842	.000		
INFORMASI	.225	.022	.455	10.014	.000	.371	2.698
PELAYANAN	.062	.021	.125	2.985	.0	.436	2.292

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Model	Unstandardized B	Coefficients Std. Error	Standardized Coefficients Beta	T	Sig	Collinearity Tolerance	Statistics VIF
KEGUNAAN	.170	.019	.386	9.052	.000	.421	2.375

Source: (Research Results, 2024)

In this research, to identify symptoms of multicollinearity, we can look at the VIF value in the output results above. It is said that there are no symptoms of multicollinearity if VIF < 10. Above VIF 2.69, 2.29 and 2.37, which is less than 10, there are no symptoms of multicollinearity.

3. Heteroscedasticity test

Table 11. heteroscedasticity test results

	Unstandardized B	Coefficients Std. Error	Standardized Coefficients Beta	t	Sig
(constatn)	3.916	.368		10.627	.000
PELAYANAN	.001	.017	.005	.053	.958
INFORMASI	.003	.019	.015	.165	.869
KEGUNAAN	-.003	.015	-.020	-.223	.823

Source: (Research Results, 2024)

It can be seen in table 11 that the Sig value is obtained. between the independent variable and the absolute residual variable is 0.958, 0.869, 0.823. The values of 0.958, 0.869, and 0.823 are more than 0.05, so it can be concluded that there are no symptoms of heteroscedasticity in all observations of the regression model

D. F Test

Table 12. F test results

Mode	Sum of Squares	Df	Mean Square	F	Sig
Regression	700.622	3	233.541	337.646	.000 [b]
Residual	201.969	292	.692		
Total	902.591	295			

Source: (Research Results, 2024)

From the table 12, the calculated F result is 337,646, which means that the calculated F value > F table = H0 is rejected, meaning that the variables of usefulness, quality of information and quality of interaction together have a significant influence on the satisfaction variable.

E. T Test

Table 13. T test results

Mode	Unstandardized B	Coefficients Std. Error	Standarized Coefficients Beta	t	Sig
(constatn)	2.527	.433		5.842	.000
KEGUNAAN	.170	.019	.386	9.052	.000
INFORMASI	.225	.022	.455	10.014	.000
PELAYANAN	.062	.021	.125	2.985	.003

Source: (Research Results, 2024)

1. Usability variable, .052 and T-table = 1.968 so that T-count > T table (9.052 > 1.968) means H0 is rejected. Thus, the usability variable partially has a significant effect on the satisfaction variable,
2. Information quality variable, T-count = 10.014 and T-table = 1.968 so T-count > T table (10.014 > 1.968), meaning H0 is rejected. Thus, the information quality variable partially has a significant effect on user satisfaction.
3. Interaction quality variable, T-count = 2.985 and T-table = 1.968 so T-count > T table (2.985 > 1.968), meaning that H0 is rejected, thus, interaction quality partially has a significant effect on user satisfaction

F. Descriptive Analysis of Respondents' Responses

In this study, a Likert scale was used to calculate the results of the questionnaire. The Likert scale is used to measure the attitudes, opinions and perceptions of a person or group about social events or phenomena (Rahardja, Sudaryono, & Chakim, 2023)

Descriptive respondents' answers in this case aim to analyze data based on the results obtained from respondents' answers to each variable measurement indicator. The measurement uses a Likert scale, where a score of 1 is given for the answer "Sangat Tidak Setuju" to a score of 5 for the answer "Sangat Setuju". Within the range of average score values, the Likert scale categories are interpreted as follows:

$$\frac{The\ highest\ score(5) - Lowest\ value\ (1)}{number\ of\ levels\ (5)} = 0{,}8$$

So the Likert scale value range categories are as follows:
1.00 – 1.80 = Very low/STS
1.81 – 2.60 = Low/TS
2.61 – 3.40 = Medium/N
3.41 – 4.20 = height/S
4.21 – 5.00 = very high/SS

Based on the table 14, it was found that respondents had a high perception of the Usability variable, with an average value of 4.05, which means they have an answer interpretation of S (Agree)

Table 14. Respondents' responses to the Usability variable

No.	Indikator Usability	Average Value of Answers	Category
1	Website Zeta Scarves mudah untuk dipelajari dan dioperasikan	4.02	High
2	Interaksi dengan website Zeta Scarves jelas dan mudah dimengerti	4.01	High
3	Mudah untuk menemukan menu-menu didalam website Zeta Scarves	4.06	High
4	Website Zeta Scarves mudah untuk digunaka	4.08	High
5	Website Zeta Scarves memiliki tampilan website yang menarik	4.15	High
6	Desain website Zeta Scarves cocok dengan jenis websiteny	4.08	High
7	Website Zeta Scarves memiliki kompetensi	4.00	High
8	Website Zeta Scarves menciptakan pengalaman positif bagi penggunanya	3.99	High
	Rata – rata	4.05	

Source: (Research Results, 2024)

Based on the table 15, respondents' perceptions of the Information Quality variable have an average value of 4.00, which means they have an answer interpretation of S (Agree).

Table 15. Respondents' responses to the Information Quality variable

No.	Indikator Information Quality	Average Value of Answers	Category
1	Website Zeta Scarves menyediakan informasi yang akurat	3.92	High
2	Website Zeta Scarves menyediakan informasi yang dapat dipercaya	3.95	High
3	Website Zeta Scarves memberikan informasi yang tepat waktu	4.02	High
4	Website Zeta Scarves menyediakan informasi yang relevan	3.99	High
5	Website Zeta Scarves menyediakan informasi yang mudah dimengerti	4.14	High
6	Website Zeta Scarves menyediakan informasi dengan detail yang tepat	4.02	High
7	Website Zeta Scarves menyajikan informasi dalam format yang tepat	3.96	High
	Rata - rata	4.00	

Source: (Research Results, 2024)

Based on the table 16, respondents' perceptions of the Service Interaction variable have an average value of 3.95, which means they have an answer interpretation of S (Agree).

Table 16. Respondents' responses to the Service Interaction Quality variable

No.	Indikator Service Interaction Quality	Average Value of Answers	Category
1	Website Zeta Scarves memiliki reputasi yang baik	3.94	High
2	Pengguna merasa aman dalam bertransaksi dalam website Zeta Scarves	3.89	High
3	Pengguna merasa aman dengan data pribadi pengguna di dalam website Zeta Scarves	3.89	High
4	Website Zeta Scarves menciptakan rasa personal atau terjaminnya privasi	3.92	High
5	Pengguna dapat dengan mudah berkomunikasi dengan perusahaan melalui website Zeta Scarves	3.99	High
6	Website Zeta Scarves menyampaikan rasa bermasyarakat atau bersosial	4.00	High
7	Website Zeta Scarves memberikan produk atau layanan sesuai dengan janji	4.00	High
	Rata - rata	3.95	

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Source: (Research Results, 2024)

Based on the table 17, respondents' perceptions of the User Satisfaction variable have an average value of 4.00, which means the answer is S/ (Agree).

Table 17. Tanggapan Responden pada variabel Kepuasan Pengguna

No.	Indikator User statisfaction	Average Value of Answers	Category
1	Merasa puas dengan kualitas pelayanan Website Zeta Scarves	3.98	High
2	Merasa puas dengan produk yang ditawarkan didalam Website Zeta Scarves	3.99	High
3	Akan sering menggunakan Website ini ketika berbelanja produk Zeta Scarves	4.02	High
4	Bersedia merekomendasikan Website ini kepada teman dan kerabat untuk belanja online	4.02	High
	Rata - rata	4.00	

CONCLUSION

The results of the evaluation of the quality of the Zeta Scarves website using the WebQual 4.0 method which has been carried out from this research can be concluded that overall the quality of usability, quality of information and quality of interaction have a positive effect on the quality of the website. And the most dominant positive influence is the quality of use. This is proven by the results of the analysis which provide positive results for each independent variable on the dependent variable (user satisfaction). Apart from that, the results of the test prove that each independent variable has a positive relationship with the dependent variable, namely user satisfaction

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INVENTORY APPLICATION DESIGN AT INDUSTRIAL WATER DEPO USING EXTREME PROGRAMMING METHOD

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Abstract—Bening Water Depo involves in selling mineral water and refill water and trading with partner entities in the water sector. In the activities of inventory management and storage as well as recording of sales, problems are found because the management of inventory recording and recording of sales made in stores often experiences data loss caused by inventory recording still in paper form or you can say it is still doing manual recording, which has the possibility of collecting lost, damaged paper, or the recorded data cannot be read clearly. The urgency is to track expenses and income if the activity in the store is too crowded and records are still in paper form. The Extreme Programming method is used in this study. Steps of the extreme programming methodology cover the application planning phase, the application design phase, the application coding phase, and finally the application testing phase by doing blackbox testing to test the functional of the system. Results of this study are a website-based inventory application with several types of features including incoming and outgoing data management, then recording goods data, customer recording, recording incoming goods transactions, outgoing transaction reports, incoming goods reports, commodity data reports, customer data reporting, as well as book reports that include sales transaction reports, reseller sales reports, and purchase or restock reports. Implementing an inventory application in a gallon drinking water business can increase operational efficiency, improve customer service, and help in making better decisions for sustainable business growth.

Keywords: Information System, Extreme programming, Inventory.

Intisari - Bening Water Depo terlibat dalam penjualan air mineral dan pengisian ulang air serta perdagangan dengan entitas mitra di sektor air. Dalam kegiatan manajemen inventaris dan penyimpanan serta pencatatan penjualan, ditemukan masalah karena manajemen pencatatan inventaris dan pencatatan penjualan yang dilakukan di toko sering mengalami kehilangan data yang disebabkan oleh pencatatan inventaris masih dalam bentuk kertas atau bisa dikatakan masih melakukan pencatatan manual, yang memiliki kemungkinan mengumpulkan kertas yang hilang, rusak, atau data yang dicatat tidak dapat dibaca dengan jelas. Urgensinya adalah melacak pengeluaran dan pendapatan jika kegiatan di toko terlalu ramai dan catatan masih dalam bentuk kertas. Metode Extreme Programming digunakan dalam penelitian ini. Langkah-langkah metodologi extreme programming meliputi tahap perencanaan aplikasi, tahap desain aplikasi, tahap pengkodean aplikasi, dan akhirnya tahap pengujian aplikasi dengan melakukan pengujian kotak hitam untuk menguji fungsional sistem. Hasil dari penelitian ini adalah aplikasi inventaris berbasis website dengan beberapa jenis fitur termasuk manajemen data masuk dan keluar, kemudian pencatatan data barang, pencatatan pelanggan, pencatatan transaksi barang masuk, laporan transaksi keluar, laporan barang masuk, laporan data komoditas, pelaporan data pelanggan, serta laporan buku yang mencakup laporan transaksi penjualan, laporan penjualan pengecer, dan laporan pembelian atau restock. Mengimplementasikan aplikasi inventaris dalam bisnis air minum galon dapat meningkatkan efisiensi operasional, meningkatkan layanan pelanggan, dan membantu dalam pengambilan keputusan yang lebih baik untuk pertumbuhan bisnis yang berkelanjutan.

Kata Kunci: Sistem Informasi, extreme programming, persediaan.

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INTRODUCTION

The rapid growth of technology and industry has had an impact on human life, both positive and detrimental (Steven & Lee, 2023). The good influence is expected for humans in order to improve the quality and comfort of life, but the negative impact is not expected because it can diminish the quality and comfort of life. This can be seen in the advancement of industrial technology, specifically the availability of clean drinking water that is extensively utilized by the public, such as gallons of drinking water, as well as refilling drinking water supplies (Savira & Abdullah, 2019).

The use of information technology is required in business and organizational operations because one of the functions of a business or organization is highly dependent on its utilization (Hilabi & Huda, 2019), (Fathurrahman & Muhammad, 2019), (Fenardi & Lee, 2023). To build an information system that is durable and can provide an advantage in the increasingly fierce competition in the business world along with the times, information technology is the first choice (Machmudi, 2019).

Inventory usage has a big impact on the company (Kartinah & Kuncara, 2022). Inventory is a significant asset within a company that can influence an organization's approach to gaining targeted profits. As a result, a comprehensive inventory control method is required (Almadany & Khair, 2022). Inventory is a process sequence that collects, records, reports, and documents stock data as a tool to support organizational activities. This information is a record of all the tools and resources available for company activities (Tannady et al., 2022). The word inventory counting refers to tracking and adjusting a company's inventory of goods and assets, either for display in a warehouse or for use in a company's business process database system. (Haerani & Desianasari, 2022).

After air, water is a necessity as well as very important for human survival. Drinking Water Depo (DWD) established by individuals or groups to carry out trade, namely to manage water so that later it is prepared for purchase to the hands of consumers. The need for water as one of the people's main food ingredients can be met with mineral water and refill water sold by DWD. Products Mineral water and refill water provided by DWD are a necessity for the community because of their uses and are relatively affordable when compared to bottled water. (Ummah & Adriyani, 2019). The provision of mineral water or refill water as a household need is strictly required to meet the standards set out in international as well as national and regional regulations (Fatimura & Masriatini, 2021).

One of business that is expanding and is seen as becoming increasingly crucial for the needs of clean drinking water is a water refill depo. Bening Water is a drinking water distribution system that began operations in 2021. Until it has more than 100 clients who believe in quality and competitive pricing that are lower than other sources of drinking water. To compete with similar companies, Bening Water employs information systems and technology, regardless of company size. With the use of information systems and technology, all corporate operations can be simplified (Sinica, 2018).

The need for clean water is rising with Indonesia's population increase. As a result, the author intends to develop and create a website at Bening Water Depo as a clean water supplier, on which the supplier may easily process customer and outcome data (Adenansi & Christianti Johan, 2021).

Bening Water Depo is a business that distributes clean water to the general public. Bening Water Depo harnesses the advancement of IT as a medium for handling business activities such as paying water bills, ordering water stock, and so on. This company has also used application technology to help internal operations such as recording transactions, recording customer data, and so on (Mediana & Nurhidayat, 2018), (Nurlaela & Utami, 2023).

Bening Water Depo is engaged in selling refill water. This means that Product records, Sales records, and Purchase records are required if you want to generate reports.

The process is still do manually on paper. This cause several problems such as stock discrepancies, loss of recording data, and the inability to generate reports. The solution that can be offered is a website-based inventory application for Bening Water Stores to record products, sales, purchases, and report generation.

Based on the problems above, it is recommended to keep records using a Inventory Application. The suggested Inventory application is made using the Extreme Programming Software Development Life Cycle (SDLC) method to ensure that the owner can use the application while still under work.

MATERIALS AND METHODS

Research and development is the approach used in this study. The research and development process is the method used to manufacture and test a particular product, to make sure how well it works. To be able to develop a particular item, the research required for analysis is used to assess the effectiveness of the product and ensure proper use.

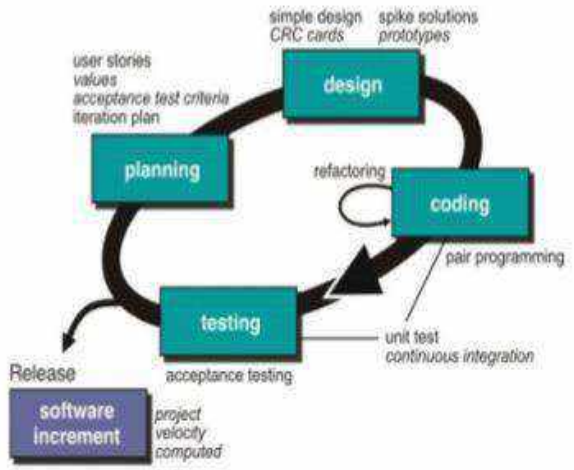

Figure 1. Extreme Programming Method (Carolina & Supriyatna, 2019)

Extreme Programming is used as an application design and manufacturing method in the study as shown in Figure 1. In the extreme programming method, there are several stages (Ahmad et al., 2020),(Garzo & Garay-Vitoria, 2021).

As a development method based on SDLC with iteration phase procedures to release where Extreme Programming itself upholds the Agile Software Development model. (Prabowo & Kuswanto, 2020). The small to mid-sized teams that the Extreme Programming approach seeks to create can also be used to create systems with rapidly changing requirements or unclear requirements (Asriyanik, 2022). Extreme programming is an iterative process that ends up in a ready-to-use system. At this point, system testing, analysis, design, and coding is complete (Septiani & Habibie, 2022).

RESULTS AND ANALYSIS

Planning

Planning focuses on obtaining an overview of the features and functions of the product to be produced. The planning process starts with gathering the visuals or narrative offered by the end user, which will serve as a basic description of the program (Djamen et al., 2020).

The purpose of this research is to plan the functional requirements that will later be in the application. Where in the application, there will be functions that have been determined according to needs. Owner as the highest authority and as the only user in the application can access all functions, starting from the Dashboard, Product Input, Sales Input, Restock Input, Customer Input, Sales History, Restock History, Sales History, Product List, Customer List, and Sales Reports.

Design

Design is the second stage of extreme programming. Design is a guide to content implementation. make a sketch of the system interface which will later be used as a reference during the coding process (Tristiyanto et al., 2020).

In this design stage, the system design has been designed using data flow diagrams or Data Flow Diagrams (DFD), entity relationship diagrams or Entity Relationship Diagrams (ERD), and wireframes that are made as needed. Data flow diagrams contain context diagrams and overview diagrams. In the making, data flow diagrams are adopted and developed because the application created is a structured application.

Data Flow Diagram

Based on Figure 2, it shows that the user (Owner) can interact. The process carried out by the Owner can add Product Data, add Sales Data, add Customer Data, add Restock data, search Product Data, search Sales Data, Search Customer data, and search Restock data. Owners can access the Dashboard, Sales Reports, Restock Reports, Customer Lists, Product Lists, Books, Sales Data Search Results, Restock Data Search Results, Customer Data Search Results, Product Data Search Results, and Book Data Search Results.

Then in Figure 3 is an Overview Diagram illustrating the course of the nine main processes contained in the Bening Water Shop Website. And from the Overview Diagram, it can be seen that the user (Owner) can provide input, get Reports, and get Lists. The owner is the main actor who will be given the highest access rights and can access all existing functions. The owner can input product data, input sales data, input restock data, and input customer data. Owners can also access all Sales Reports, Restock Reports, Product Lists, Customer Lists, and Book Reports. Each input made will be stored in its respective data stores.

Data Flow Diagram (DFD) is a graphic that represent how application data flow and what data that exist in the application that are designed. The purpose of making a DFD is to explain scope and boundaries of data in the system.

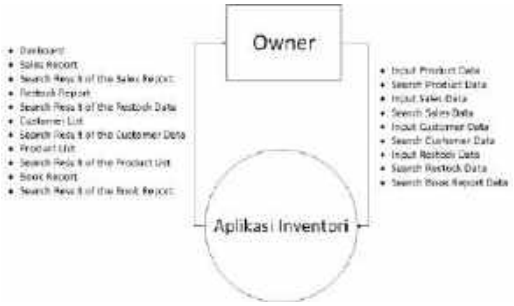

Figure 2. Diagram Context

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Figure 3. Diagram Overview

As Shown in Figure 3 from Process 1 until 4, Owner can Input Product Data, Sales Data, Restock Data, and Customer Data into the Data Store which is the DBMS that act as the Data Store in this study.

Same goes as the Output that shown from Process 5 until Process 9, the Owner can see data that already exist or data that the Owner previously inputted into the data store, which divided same as Input such as Sales Report, Restock Report, Product List, Customer List, but especially Book Report that will Show Income from sales and Outcome from Restock.

Entity Relationship Diagram

The database axis conceptual model is described in an entity relationship diagram (Yoraeni et al., 2020.). In the designed Bening Water Store Inventory application, data is stored in the MySQL DBMS. Meanwhile, these data are interconnected to produce information that is easy to understand. The Entity Relationship Diagram in Figure 4 shows how data is connected to one another.

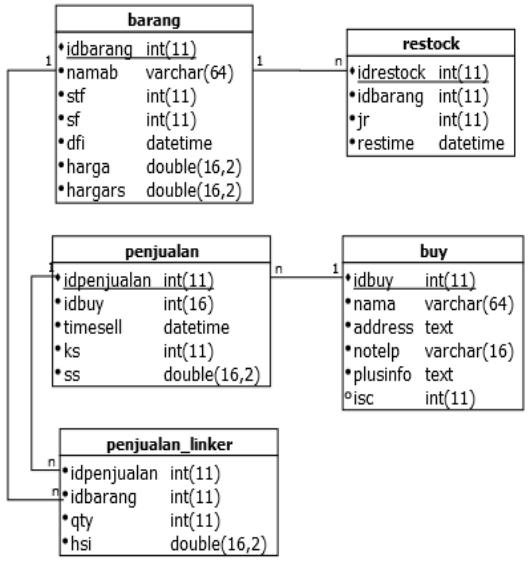

Figure 4. *Entity Relationship Diagram*

Wireframe

Wireframe is a blueprint or design for application pages that will be worked on by application developers, and indeed this design is also mostly a reference for how the application will be made later (Andrian et al., 2020). The Dashboard display has menus for Product Input, Sales Input, Restock Input, Customer Input, Restock History, Sales History, Product List, Customer List, and Books. On the Dashboard at the top right corner there is a Logout feature.

In the wireframe Product Input menu, there's Product Name field, price for buying the product field, price for selling field, and current stock quantity field. Then there's submit button and reset button at the end of the form.

In the wireframe Sales Input menu, there's Item selection field, Price for Sales, Customer field selection, Product status field, and Purchase Status field. Then there's submit button and reset button at the end of the form.

In the wireframe Customer Input menu, there's Customer Name Field, Customer telephone number field, customer address field, extra note field, and Customer type selection field.

In the wireframe Input Restock menu, there's Product selection field, quantity of the restock field, and type of the restock selection field.

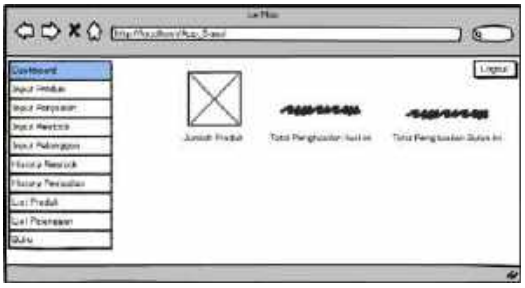

Figure 5. *Wireframe Dashboard*

As for the History and List menu in the wireframe. Each menu have table that contain correspondent page. Like in the Restock History and Sales History page there's table that will show the Restock and Sales data. The same goes for Product List and Customer List page, the page have table that contain Product Data and Customer Data at each own page. But Book Report page are showing data that are combined, the data itself are Sales Data and Restock Data that are combined and Calculated to produce the Correct Revenue.

Results

The research that has been carried out by the author produces results in the form of Inventory applications. The following are the results of the study in the form of an screenshot of the application: Figures 6 are upper Dashboard displays, where Daily and Monthly Income Graphs are shown. The graphs are shown in bar style and can be highlighted to show the maximal income of the day.

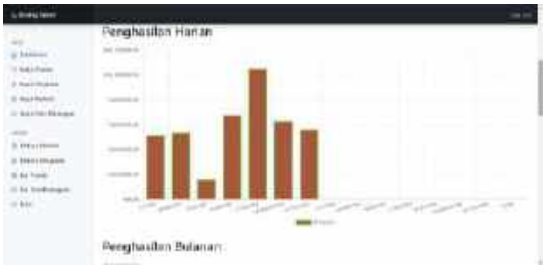

Figure 6. Screenshot of the Bening Water Depo Inventory Application

Figures 7 are bottom Dashboard displays, where the top 5 best selling product are shown in table and donut chart. The Donut Chart are showing how much the product are selled while the table are showing the total amount of the income from the product. The results obtained from blackbox testing of the Basic application features in Bening Water Store Inventory, produce good results for each of its functions as shown in Table 1.

Figure 7. Screenshot of the Bening Water Depo Inventory Application

Table 1. Blackbox Testing Basic Features

No	Test Case	Test Steps	Expected Result	Actual Result	Status
1	Login	1. 1. Open the website of the application 2. Shown Login page 3. Input the Username 4. Input the Password 5. Click "Masuk"	The user has successfully logged into the application	The user has successfully logged into the application	OK
2	Logout	Click "Sign Out" button	The user has successfully signed out of the application	The user has successfully signed out of the application	OK

The results obtained from blackbox testing of the Basic features in the Bening Water Depo Inventory Application, produced good results on each function as described in Table 1. Login are tested to make sure the user can log on to the application without any problem and the result of the test are showing the login function of the website are working correctly and as intended. Sign Out are tested to make sure the user can log out from the application and close the site without any problem whatsoever. The Reason for the Sign Out function are being tested is to prevent the jam of the login session that tried to destroy by the sign out function that can led to the application being accessed by other user.

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Table 2. Blackbox Testing Output Features

No	Test Case	Test Steps	Expected Result	Actual Result	Status
1	View Restock data	Select "History Restock" Menu	The appearance of a Table containing a list of Restock transactions	The appearance of a Table containing a list of Restock transactions	OK
2	View Sales data	Select the menu " History Penjualan"	The appearance of a table containing a list of Sales transactions	The appearance of a table containing a list of Sales transactions	OK
3	View Customer data	Select "List Pelanggan" Menu	Appearance of a Table containing a list of Customer Data	Appearance of a Table containing a list of Customer Data	OK
4	View Product data	Select "List Produk" Menu	Appears of a Table containing a list of Product Data	Appears of a Table containing a list of Product Data	OK
5	View the "Buku" report page	Select "Buku" Menu	The appearance of a Table containing a list of Restock and Sales transactions merged	The appearance of a Table containing a list of Restock and Sales transactions merged	OK

The results obtained from blackbox testing of the Output feature on the Bening Water Depo Inventory Application, produced good results for each function as described in Table 2. View Restock Data, View Sales data, View Customer data, View Product data, and View "Buku" Report page are

tested to make sure the user of the application can access the History of each correspondent function, such as Restock History that will show the History of Restock that ever been done, same as Sales data. But Customer data and Product Data are tested to make sure the user can see the Data of the Product and Customer that been inputted. For the "Buku" Report Page, it contain the History of the Sales and Restock that the data are joined and shown together in the table with each transaction are labeled to coresspondent type and calculated to show the correct amount of revenue.

The results obtained from *blackbox testing* of the *Input* feature in the Bening Water Depo Inventory Application, produced good results for each function as described in Table 3. Input Sales Data, Input Restock, Input Customer Data, and Input Product Data also being tested to make sure user can use each function correctly without any failure on the input progress. Form of the Input Product, Input Sales, Input Restock, and Input Customer Data must filled before pressing the submit function, where the submit function itself will record the inputted data and store it in the database that designated previously.

Table 3. Blackbox Testing Input Features

No	Test Case	Test Steps	Expected Result	Actual Result	Status
1	Input Product Data	1. Select " Input Produk" menu 2. Fill "Nama Produk" Field 3. Fill "Harga Satuan Produk untuk Dijual" Field 4. Fill "Harga Satuan Produk saat Dibeli" Field 5. Fill "Kuantitas Produk" Field	User successfully inputs product data	User successfully inputs product data	OK
2	Input Sales Data	1. Choose "Input Penjualan" menu 2. Choose "Produk" 3. Fill "Jumlah Penjualan Produk" Field 4. Choose "Pembeli" 5. Choose "Status Pembayaran" 6. Choose "Status Pengiriman" 7. Click"Submit Button"	User successfully inputs sales data	User successfully inputs sales data	OK
3	Input Restock	1. Choose Product 2. Fill "Jumlah Restock" Field 3. Choose "Jenis" 4. Click "Submit" button.	User Successfully Inputs Restock Data	User Successfully Inputs Restock Data	OK
4	Input Customer Data	1. Fill "Nama" Field 2. Fill "Alamat Rumah" Field 3. Fill "Nomor Telpon" Field 4. Fill "Keterangan Tambahan" Field 5. Choose Tipe"	User successfully inputs customer data	User successfully inputs customer data	OK

No	Test Case	Test Steps	Expected Result	Actual Result	Status
		6. Click “Input Pelanggan” button			

CONCLUSION

the application developed based on the conducted studies provides comprehensive functionalities for Toko Bening Water, allowing efficient recording of product, customer, sales, and restock data. Additionally, it facilitates report generation, including sales and restock reports, product and customer lists, and graphical representations of sales data. Users are required to input relevant information for each data recording, such as product details, sales information, restock details, and customer information. The application has been successfully implemented at Bening Water Depo, demonstrating its effectiveness without any functional issues during testing. It is designed exclusively for the depo owner, ensuring a single user interface tailored to their needs

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DEVELOPMENT OF A SYSTEM TRANSFORMATION OF NEW STUDENT ADMISSION SERVICES AND VALUE MANAGEMENT

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Abstract— *Service activities at Tegal Dinamika Vocational School still use a manual system which has a high risk of data being lost and the authenticity of its value is doubtful. Based on these conditions, it is necessary to create a web-based grade processing information system to help convey information on student grades and attendance, as well as online registration data. The aim of this research is to provide a breakthrough in the transformation of services at Vocational School Dinamika Tegal in terms of registering new students, conveying information on exam results and attendance recaps to students and parents, which can be accessed online via the website, so that all users, even people with physical limitations, can access the website. that easily. The research method for web design uses the SDLC waterfall method. Apart from that, to determine website performance, researchers conducted sample usability testing to find out whether the website was user friendly. The results of this research with the creation of this application, the process of conveying value information from teachers to students has become more effective and efficient, this evidence can be seen from the distribution of questionnaires in the school environment which shows that 97% agree with this research, increasing the success of data processing and making it easier for the administrative side to be more organized and no more data errors. The uniqueness of this research focuses on more disability-friendly web design and user experiences that are accessible to all individuals including those with disabilities. The conclusion of this research is that the website is able to manage grade data and student attendance recaps that have been input by the teacher, making it easier for prospective new students to obtain registration information and register online and can be accessed anywhere and at any time through the system.*

Keywords: *Grades, information systems, registration, waterfall, web.*

Intisari— *Kegiatan pelayanan di SMK Dinamika Tegal masih menggunakan sistem manual yang tinggi resiko data hilang serta diragukan keaslian nilainya. Berdasarkan kondisi tersebut perlu kiranya untuk membuat sebuah system informasi pengolahan nilai berbasis web untuk membantu menyampaikan informasi nilai dan kehadiran siswa, serta data pendaftaran secara online. Tujuan penelitian ini yaitu memberikan trobosan transformasi pelayanan di SMK Dinamika Tegal dalam hal pendaftaran siswa baru, penyampaian informasi nilai hasil ujian dan rekap kehadiran kepada siswa maupun wali murid dapat diakses secara online melalui website, sehingga seluruh pengguna bahkan orang yang memiliki keterbatasan fisik dapat mengakses website tersebut dengan mudah. Metode penelitian pada perancangan web ini menggunakan metode SDLC waterfall. Selain itu untuk mengetahui performa website, peneliti melakukan sample usability testing untuk mengetahui apakah website user friendly. Hasil dari penelitian ini dengan terciptanya aplikasi ini, proses penyampaian informasi nilai dari guru kepada siswa menjadi lebih efektif dan efisien, bukti ini dapat dilihat dari sebaran kuesioner dilingkungan sekolah yang menunjukan 97% menyetujui penelitian ini meningkatkan keberhasilan pengolahan data dan mempermudah pihak administratif menjadi lebih tertata dan tidak ada lagi kesalahan data. Keunikan penelitian ini berfokus pada desain web yang lebih ramah disabilitas dan pengalaman pengguna yang dapat diakses oleh semua individu termasuk mereka yang memiliki keterbatasan. Kesimpulan dari penelitian ini, website mampu mengelola data nilai dan rekap kehadiran siswa yang telah diinput oleh guru, memudahkan calon siswa baru mendapatkan informasi pendaftaran dan mendaftar secara online dapat diakses dimana saja dan kapan saja melalui sistem*

Kata Kunci: *Nilai, sistem informasi, registrasi, waterfall, web.*

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INTRODUCTION

The increasingly rapid development of information and communication technology also influences the development of information systems, one of which is in the world of education (Fitri, Mahdiawan, 2023). In the education sector we can find developments in information systems such as online libraries, academic information systems and new student registration, but not many schools still implement or use information systems in this process (Zen, Rahman, Dafitri, Liza, & Aulia, 2023), In this digital era, online registration of new students or acceptance of new students (PSB) is one form of solution so that the implementation of new student registration is more transparent, easy to collect data, and informative(Zen et al., 2023). In fact, having online registration will really help schools in registering new prospective students, with data that is neater and easier to process compared to using manual registration(Harry Saptarini, Hidayat, & Ciptayani, 2019), besides this system will make it easier to collect data and the administration process is easier and faster, the implementation of student registration will be more efficient in terms of time, space costs and energy (Pratiwi, Jubaidah, Julieta, & Putri, 2023) .

Apart from registering new students, the information system can also be used to assist the process of inputting student grades carried out by teachers or teaching staff (Limbong & Sriadhi, 2021). The existence of this information system will make it easier for teachers in the process of inputting grades, data collection and transparency in giving grades, as well as in teacher reporting in providing recaps. Student grades will be easier (Sari, Azzahrah, Qathrunada, Lubis, & Anggraini, 2022).

This research needs to be carried out because in today's sophisticated era, most of the service conditions at Dinamika Tegal Vocational School are still carried out manually in various important services such as the delivery of exam results and attendance recapitulation which still have to be delivered directly by teachers in class as well as student registration services. The new policy requires prospective students to come directly to school to process registration and have to return to school when there is information regarding new student registration, so this is considered less efficient.

With the idea of building a web-based information system for new student admissions and inputting student grades using PHP and HTML programming languages and using a SQL database (Noviantoro, Silviana, Fitriani, & Permatasari, 2022). Hypertext Markup Language (HTML) is used to regulate the way we present information on the internet and how that information takes us from one place to another, while PHP is used to develop the web (Rina Noviana, 2022). MySQL has good enough capabilities to support the work of developers, both users who have experience with databases and beginners. MySQL uses the SQL language to access its database (Raharjo, Napiah, & Anwar, 2022). With this system, it is hoped that it will make it easier for the school or committee to manage the implementation of new student admissions, and with the existence of a web-based value input system (Mayasari, Supriani, & Arifudin, 2021) it will make it easier for teachers to record and provide grades for their students anywhere, because it is systemized and web-based so it can be accessed anywhere and at any time.

In research conducted by (Jamaludin, Firmansyah, & Romli, 2023) the design of a special PPDB website (admission of new students) can record every PPDB process starting from PPDB information, registration, viewing student statistics, and viewing information about the school. And finally, the process of accepting new students is more effective and efficient because the entire process has been computerized so that the process of accepting new students, the incoming data is more organized and easy to access if needed, without using conventional data in the form of paper anymore, and also from a security perspective. safer because the data is stored in a database that can only be accessed by the school admin.

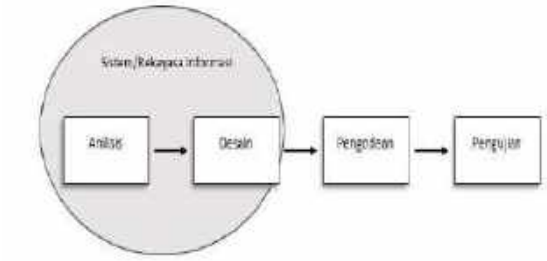
Based on these problems, the researchers proposed a new breakthrough by designing a user friendly website using the SDLC waterfall method with a sequential approach. Where is the uniqueness of this research compared to other research conducted by (Jamaludin et al., 2023) which focuses more on the student registration system with the same method, namely the waterfall method, in this research even though the website designed is a website that has 3 main features, because not only focuses on the new student registration website but also includes features for informing exam results and recapitulating student attendance, but based on the results of sample usability testing or filling out questionnaires filled out by students at SMK Dinamika Tegal, it shows that 97% agree that this research increases the success of data processing and makes things easier for the administrative side. organized and no more data errors. Apart from that, this website is also equipped with a new breakthrough where this website is set to be user friendly not only for ordinary people but also friendly for people with special needs because it is equipped with disability access where in the website usage guide there are voice steps to make it easier to access the website.

MATERIALS AND METHODS

The data collection techniques that will be used to obtain data appropriate to the problem being studied are:

1. Observation
   By seeing and observing directly sales as a problem object for the writer(Fachri & Surbakti, 2021).
2. Interview
   By asking questions or providing a list of questions to the resource person, the public usually relates to purchasing needs related to the problem being discussed and the resource person immediately answers.
3. Literature Study
   This is a search for literature sourced from books, media, experts or the results of other people's research which aims to develop the theoretical basis that we use in conducting research(Fadli & Pardiyansyah, 2022). One reference source that researchers can use as information guides in searching for reading material is by using reference books.

SDLC has several models for implementing the process stages, one of the models used in this final project is the waterfall model. According to Rosa and Shalahudin in "The waterfall SDLC model is often also called the linear sequential model or classic life cycle"(Okesola et al., 2020).



Source: (Okesola et al., 2020)

Figure 1: illustrates the Waterfall Model

The waterfall model provides a sequential or ordered software life flow approach starting from analysis, design, coding, testing and support stages(Putra & Ridoh, 2021). Here is the explanation:

1. Analysis of software requirements
   The requirements gathering process is carried out intensively to specify software requirements so that it can be understood what kind of software is needed by users.
2. Design
   Software design is a multi-step process that focuses on software program creation design, interface representation and coding procedures(Mersita et al., 2022). This stage translates software requirements from the requirements analysis stage to a design representation so that it can be implemented as a program at the next stage.
3. Creation of program code
   The design must be translated into a software program. The result of this stage is a computer program according to the design that was created at the design stage(Hidayat et al., 2020).
4. Testing
   According to (Firdaus, Silvy Amelia, Ani Yoraeni 2021)"Black Box Testing is testing software in terms of functional specifications without testing the design and program code." Testing focuses on the software from a logical and functional perspective and ensures that all parts have been tested. This is used to minimize errors and ensure the output produced is as desired.
5. Support or maintenance
   It does not rule out the possibility that software will experience changes when it is sent to the user. Changes occur due to errors that appear and are not detected during testing or the software must adapt to a new environment(Maulidda & Jaya, 2021).

RESULTS AND DISCUSSION

1. Analysis of software requirements

At this stage, the process of using the new student admission system and inputting student grades is web-based and contains data that can be seen by the admin, in the form of student data, teacher data, grade data, prospective new student data. The following are the results of a questionnaire issued to measure the effectiveness of the system:

Figure 2: Questionnaire Results

Based on Figure 2 above, it can be seen that the results of distributing questionnaires or filling in usability testing samples carried out by users from the Tegal Dinamika Vocational School environment show that 97% agree that this research increases the success of data processing and makes it easier for administrative parties to be more organized and there are no more data errors.

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2. System Design

After analyzing the system requirements for the new student registration system and value input at SMK DInamika Tegal, the next step is to design the system, which has the aim of how the system will be formed.

a. Process Design

1) Entity Relationship Diagram

ER diagrams help visualize how data is connected and are useful for constructing the relational databases used in these systems:

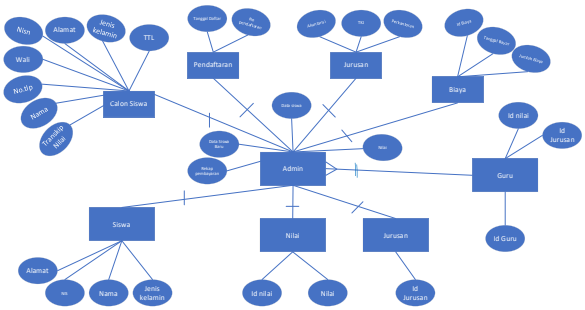

Figure 3: Entity Relationship Diagram

Figure 3 is the ERD design of the system proposed by the researcher, where it can be explained that in the ERD:

a) First, participants choose to register using the system and re-register to get a user and password
b) Then the admin will send the user and password results to prospective students who will register
c) Participants log in to the new student admissions system and the admin receives detailed data
d) Superadmin accesses the system to filter and cross-check detailed registration data

2) Data Flow Diagram (DFD)

This data flow diagram documents the processes of a system that determine the function of the system. By providing information, either storing or transferring information to the system. The following is a picture of this DFD system.

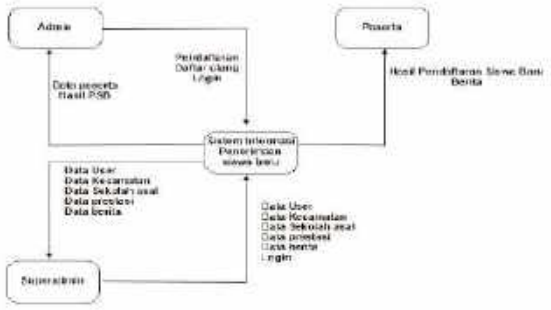

Figure 4: Data Flow Diagram (DFD)

Figure 4 is a DFD design of the system proposed by the author. Based on the DFD display above, it can be explained that the information system for new student admissions has the following flow:

a) First, participants choose to register using the system and re-register to get a user and password
b) Then the admin will send the user and password results to prospective students who will register
c) Participants log in to the new student admissions system and the admin receives detailed data
d) Superadmin accesses the system to filter and cross-check detailed registration data

3. Creation of program code

`The interface model design for the new student registration system and input of student grades is as follows:

a) Login Page

On this page the user inputs the username and password in the username and password columns so that they can enter the system:

Figure 5: Login Form

In the Login Form from figure 5, there is a Username and Password as well as account categories such as student, prospective student, teacher, admin. In the login form there are also instructions, if you don't have an account, you can register, especially for prospective new students

b) Student Registration Page

On this page, prospective new students input their personal data to register as prospective students:

Figure 6: Student Registration Form

The registration form for prospective new students contains several pieces of information that need to be completed, such as name, name of the student's guardian, guardian's telephone number, gender, religion and NISN.

c) Admin Dashboard Page

This display is the initial display after the admin logs in to the system:

Figure 7: Admin Page Dashboard

The admin dashboard form contains data on students, teachers, grades, registration. Admin access rights in this system are very comprehensive.

d) Teacher data page in admin

This page displays teacher data that has been stored in this system database, and you can edit this data or add new data:

Figure 8 :Teacher Data Admin Page

The teacher dashboard form has menus for students, teachers, grades and settings where the teacher's access rights here only extend to inputting grades and reporting on classroom learning.

d) Student page

Figure 9: New student dashboard page

The student dashboard contains identity, guardian, major, achievements, graduation status, grades. This display aims to enable students and parents to monitor learning outcomes in class.

4. Testing

Testing is intended to determine whether the functions, input and output of the software comply with the required specifications.

Table 1. Validation on the Login Form

No	Test scenarios	Expected results	Result
1	Enter the correct login data then click the login button.	The system receives login access and then displays the main menu display	**Valid**
2	Just fill in the username and empty the password and immediately click the login button	The system will deny login access and display the message "Data cannot be empty".	**Valid**
3	Just fill in the password and empty the username directly to the login button	The system will deny login access and display the message "Data cannot be empty".	**Valid**

Table 2. Validation Student Registration Form

No	Test scenarios	Expected results	Result
1	Enter data on the new student registration form	The system stores the input results for new student registration	**Valid**

Table 3. Validation Admin Page Dashboard

No	Test scenarios	Expected results	Result
1	Enter new teacher data on the Add teacher page	The system receives and stores teacher data and displays it on the teacher data page	**Valid**
2	Enter new student data on the add student page	The system receives and stores student data and displays it on the student data page	**Valid**
3	Edit/update Teacher Data	The system stores the results of updating/editing teacher data	**Valid**
4	Edit/update Student Data	The system stores the results of updating/editing student data	**Valid**
5	Edit/update Password	The system saves the results of updating/editing the password	**Valid**

No	Test scenarios	Expected results	Result
6	Erase Data	System Delete the results of updating/editing data	**Valid**

Table 4. Validation Teacher Data Admin Page

No	Test scenarios	Expected results	Result
1	System Delete the results of updating/editing data	The system stores the results of updating/editing data	**Valid**
2	Edit/update Password	The system saves the results of updating/editing the password	**Valid**
3	Delete Value Data	System Delete update/edit results	**Valid**

Table 5. Validation Page of Student Value Data on Teachers

No	Test scenarios	Expected results	Result
1	System Delete the results of updating/editing data	The system stores the results of updating/editing data	**Valid**
2	Edit/update Password	The system saves the results of updating/editing the password	**Valid**
3	Delete Value Data	System Delete update/edit results	**Valid**

5. Support or maintenance

Improved display adjustments to the conditions for implementing New Student Admissions, such as real-time information/data.

CONCLUSION

Based on the results of the research and discussion, conclusion the web-based Information System for Admission of New Students and Inputting Student Grades at Dinamika Tegal Vocational School with PHP and SQL programming languages has been successfully developed. This system is able to manage the implementation of New Student Admissions, namely registration, and the system is able to manage student grade data that has been input by the teacher, Make it easy for prospective new students to obtain registration information and register online through this system.

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