Published online on the page : https://ejournal.iainbukittinggi.ac.id/index.php/ijokid/

Knowbase : International Journal of Knowledge in Database

| ISSN (Print) 2798-0758 | ISSN (Online) 2797-7501 |

Application of Case Based Reasoning Using The K-Nearest Neighbor Algorithm in an Expert System for Diagnosing Pests and Diseases of Sugarcane Plants

Andi Maulidinnawati Abdul Kadir Parewe[1], Mursalim[2], Titis Sari Putri[3,], Hermawati[4]*

[1,2,4]Universitas Teknologi Akba, Makassar, Indonesia
[3]Institut Pemerintahan Dalam Negeri, Jatinangor, Indonesia

Article Information

Article History:
Accepted by the Editor: December 27, 2022
Final Revision: December 27, 2022
Published Online: December 29, 2022

Key Word

Case Based Reasoning
KNN
Disease
Sugarcane

Correspondence

E-mail: titissp@ipdn.ac.id*

ABSTRACT

Sugarcane pests and diseases are still diagnosed manually, which can lead to errors such as data loss or inaccurate data. The goal of this research is to develop an expert system for identifying plant pests and diseases that affect sugarcane yield and quality. This data was obtained through literature study, observation, and interviews. The Case Based Reasoning method is used to find cases by comparing previous cases with recent cases using similarity calculations with the K-Nearest Neighbor algorithm to find the best solution from the identified cases. The results of this study indicate that the expert system for diagnosing sugarcane pests and diseases is easy to use, the appearance is easy to reach, and the diagnostic process does not take a long time. Based on testing the accuracy of the system to diagnose according to the expert's mind, it got an accuracy of 96% from 50 cases tested with the system and got a percentage result of 87.33% from 10 respondents including very feasible criteria.

1. Introduction

Sugarcane is a plantation crop as raw material for the sugar industry. This industry has the potential to be developed because it produces the main product in the form of sugar which is one of the strategic commodities for the Indonesian economy and is one of the nine staples consumed by the public. Sugar is also a material for other industries, including the food and beverage industry [1].

Camming Sugar Factory located in Wanuawaru, Libureng District, Bone Regency, is a sugar cane plantation company engaged in the production of granulated sugar. However, there are several factors that affect the continuity of production including the presence of pests and diseases of sugarcane. The Camming Sugar Factory needs a system for early diagnosis of sugarcane pests and diseases as they affect the yield and quality of sugarcane. The diagnostic process so far is still using a manual recording of symptoms that attack sugarcane it can lead to errors such as data loss or inaccurate data.

Various methods for diagnosing sugarcane pests and diseases have been proposed by researchers, including Certainty Factor [2] and Dempster Shafer [3]. Certainty Factor and Dempster Shafer methods are very appropriate to be used to measure the level of certainty in diagnosing a disease. The calculations of

http://dx.doi.org/10.30983/ijokid.v2i2.5959

these methods are only used in one count so that their accuracy is maintained. However, if more than two data sets are processed, the stages of calculating the level of certainty using these methods must be repeated. In addition to these methods, there are others that work well with large amounts of data, such as the K-Nearest Neighbor method.

K-Nearest Neighbor is a simple method that is easy to implement. KNN is used to solve cases by calculating the shortest distance between recent cases and previous cases. The advantages of KNN include being strong against noise training data, namely data with a very far range of values compared to other data. However, the KNN method also has a weakness that is less than optimal in determining the value of k which is the number of nearest neighbors and is required to select features to get the best solution.

A solution is proposed based on the problems raised in this study by using the Case Based Reasoning method with similarity measurements using the KNN algorithm. The Case Based Reasoning method is used to find the case with the highest similarity, and the KNN algorithm is used to find the value of similarity between the previous and recent cases. The proposed method is more efficient because it uses previous cases and adapts recent cases to get the best solution from the identified cases.

2. Method

As a solution, the case-based reasoning analysis method and the k-nearest neighbor algorithm, abbreviated KNN, were used in the study. Each has its own advantages, with case-based reasoning being the most flexible because it can collaborate with multiple methods to achieve the best results, and KNN being simple to repair data from its own data.

2.1. Case Based Reasoning

In the case-based reasoning (CBR) method, there are several phases that can be seen in the drawings and work steps as follows :

2.1.1. Retrieve

Retrieve the most similar or the same cases. This task begins with a description of one/some problems and ends when the most suitable previous case has been found. Its sub-tasks refer to feature identification, initial matching, search, and selection [4].

2.1.2. Reuse

Reuse information and knowledge from the case to solve new problems. The process of reuse of case solutions that have been obtained in the context of new cases is focused on two aspects, namely: (a) Differences between previous and current cases; (b) What part of the acquired case can be transferred into a new case [5].

2.1.3. Revise

Review or improve the proposed solution. This phase consists of two tasks, namely: (a) Evaluating case solutions generated by the reuse process. If successful, then continue with the retain process; (b) If not then improve the case solution using specific domain knowledge [6].

2.1.4. Retain

Save or explore parts of previous experience that may be useful for solving problems in the future. This process consists of choosing what information from the case to store, in what form, how to structure the case to make it easy to find similar problems, and how to integrate recent cases into the memory structure [7].

2.2. K-Nearest Nearboard

In general, the way the KNN algorithm works is as follows. Determine the number of neighbors (K) that will be used for class determination considerations. Calculate the distance from the new data to each data point in the dataset. Take a number of K data with the closest distance, then determine the class of the new data.

2.3. *Blackbox Testing dan User Acceptance Test*

This study uses blackbox testing and user acceptance test (UAT) as a method of testing the system. Black box testing or known as behavioral testing is a test that is carried out in full only by assessing the needs and specifications of software and will reach the input and output of the software system without any knowledge of the program's internals and this test is very important because it can describe the perspective of the examiner who likes just looking at a black box and being able to find glitches or bugs in an app before it's officially released [8]. Blockchain verification and validation: Techniques, challenges, and collaborative research directions blackbox testing is a software testing approach that tests the functionality of the software under test without regard for its implementation specifics, internal route knowledge, or internal code structure. This type of testing is entirely dependent on the software's specifications and requirements [9].

3. Results and Discussion

3.1. *System and Program Trial*

The tests performed on the expert system for diagnosing sugarcane pests and diseases are blackbox testing, which is used to determine whether the software built works properly and as expected. Test results can be seen in the Table 1, Tabel 2, Tabel 3, Tabel 4, and Tabel 5. The system was tested with the following components:

Table 1. Login Test

	Cases and Test Results
Test	User login
Which is expected	The system successfully entered the user's home page
Conclusion	Succeed

Table 2. Testing The User Data Menu

	Cases and Test Results
Test	User data
Which is expected	The system successfully displays user data, adds users, changes users, and deletes users
Conclusion	Succeed

Table 3. Testing The Garden Data Menu

	Cases and Test Results
Test	User login
Which is expected	The system successfully entered the user's home page
Conclusion	Succeed

Table 4. Pest and Disease Data Menu Testing

	Cases and Test Results
Test	Data Garden
Which is expected	The system successfully displays garden data, adds gardens, changes gardens, and deletes gardens
Conclusion	Succeed

Table 5. Testing The Symptom Data Menu

	Cases and Test Results
Test	Symptom data
Which is expected	The system successfully displays symptom data, adds symptom data, changes symptoms, and deletes symptoms.
Conclusion	Succeed

Based on the results of system testing using blackbox testing techniques, it is possible to conclude that the overall system was successful and worked as expected.

3.2. System Testing

The next stage of testing is to compare the results of expert diagnoses with an expert system built to diagnose sugarcane pests and diseases using the Case Based Reasoning method. Table 6 show systems testing.

Table 6. Systems Testing

No	Symptom Code	System Results
1	G0006, G0011, G0012	Rat
2	G0002, G0003, G0007, G0010	Shoot borer
3	G0005, G0008, G0015, G0016	Armyworm
4	G0039, G0041, G0042	Root and stem based rot
5	G0013, G0014, G0016	White flea
6	G0019, G0021, G0022	Mite
7	G0006, G0009, G0010	Boktor
8	G0003, G0004, G0041	Stem borer
9	G0033, G0034, G0037	Pokahbung
10	G0024, G0025, G0026	Fire wound
11	G0001, G0004, G0005, G0006	Stem borer
12	G0008, G0011, G0012	Rat
13	G0043, G0044, G0048	Rust disease
14	G0041, G0042, G0047	Root and stem base rot
15	G0032, G0037, G0038	Scorched leaf disease
...	...	...
50	G0014, G0025, G0026	Fire wound

The next stage of testing was carried out to compare the results of expert diagnoses with an expert system built to diagnose sugarcane pests and diseases using the Case Based Reasoning method. Table 7 show comparison of expert and system diagnostic results.

Table 7. Comparison of Expert and System Diagnostic Results

No	Diagnosis Result		
	Expert Result	System Result	Description
1	Rat	Rat	In accordance
2	shoot borer	shoot borer	In accordance
3	Army caterpillar	Army caterpillar	In accordance
4	Root and stem rot	Root and stem rot	In accordance
5	White feather lice	White feather lice	In accordance
6	Mite	Mite	In accordance
7	Boktor	Boktor	In accordance

8	stem borer	stem borer	In accordance
9	Pokahbung	Pokahbung	In accordance
10	fire wound	fire wound	In accordance
11	stem borer	stem borer	In accordance
12	Rat	Rat	In accordance
13	rust disease	rust disease	In accordance
14	Root and stem rot	Root and stem rot	In accordance
15	Leaf scorch disease	Leaf scorch disease	In accordance
16	Mosaic disease	Mosaic disease	In accordance
17	stem borer	stem borer	In accordance
18	Blendok disease	Blendok disease	In accordance
19	shoot borer	shoot borer	In accordance
20	Leaf scorch disease	Leaf scorch disease	In accordance
21	Targeted spot	Targeted spot	In accordance
22	Leaf scorch disease	Fusarium stem rot	It is not in accordance with
23	Cicadas	Cicadas	In accordance
24	Ureth	Ureth	In accordance
...	...	...	...
50	Fire Wound	Fire Wound	in accordance

3.3. *App Installation Manual*

The steps taken to run this application are as follows: (1) Running star command on apache and mysql in xampp application; (2) Save the application in the directory xampp/htdocs/foldername; (3) Import the database at http://localhost/phpmyadmin/; (4) Open the chrome app and enter http://localhost/foldername. Figure 1 show interface open system localhost.

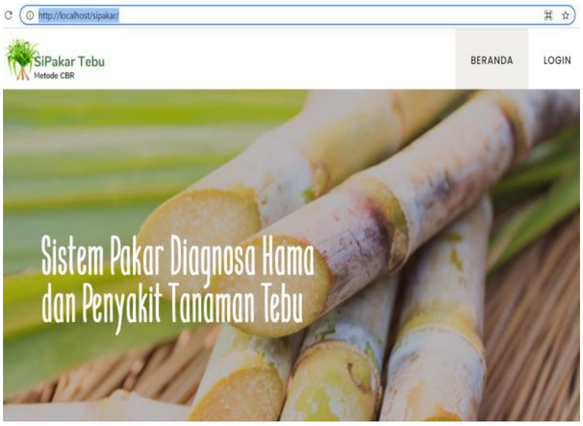
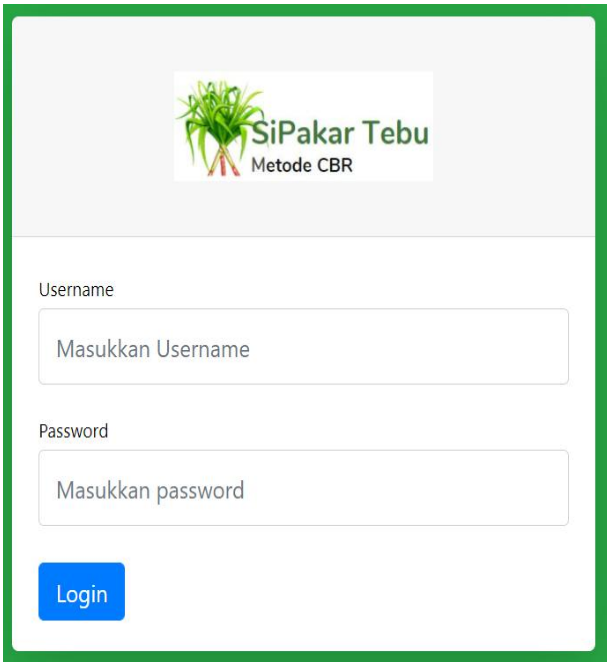

http://localhost/sipakar/
SiPakar Tebu
Metode CBR
BERANDA
LOGIN
Sistem Pakar Diagnosa Hama
dan Penyakit Tanaman Tebu

Figure 1. Interface Open System Localhost

3.4. *Application Program Manual*

The following is a display of the expert system program for diagnosing sugarcane pests and diseases. Figure 2 show login page, Figure 3 show symptom data display page, Figure 4 show expert page, and Figure 5 show diagnosis page.



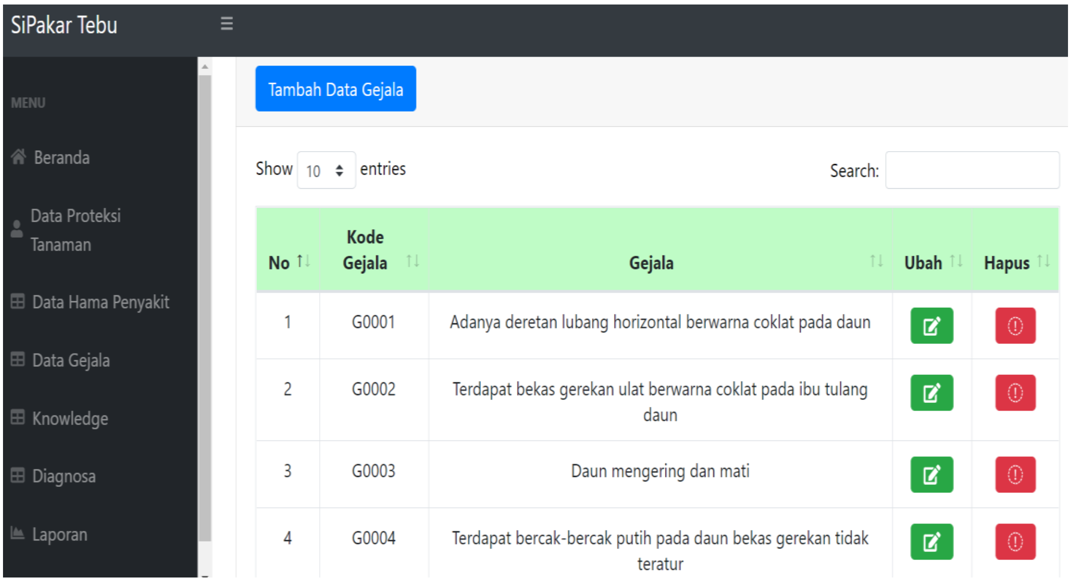
Username

Masukkan Username

Password

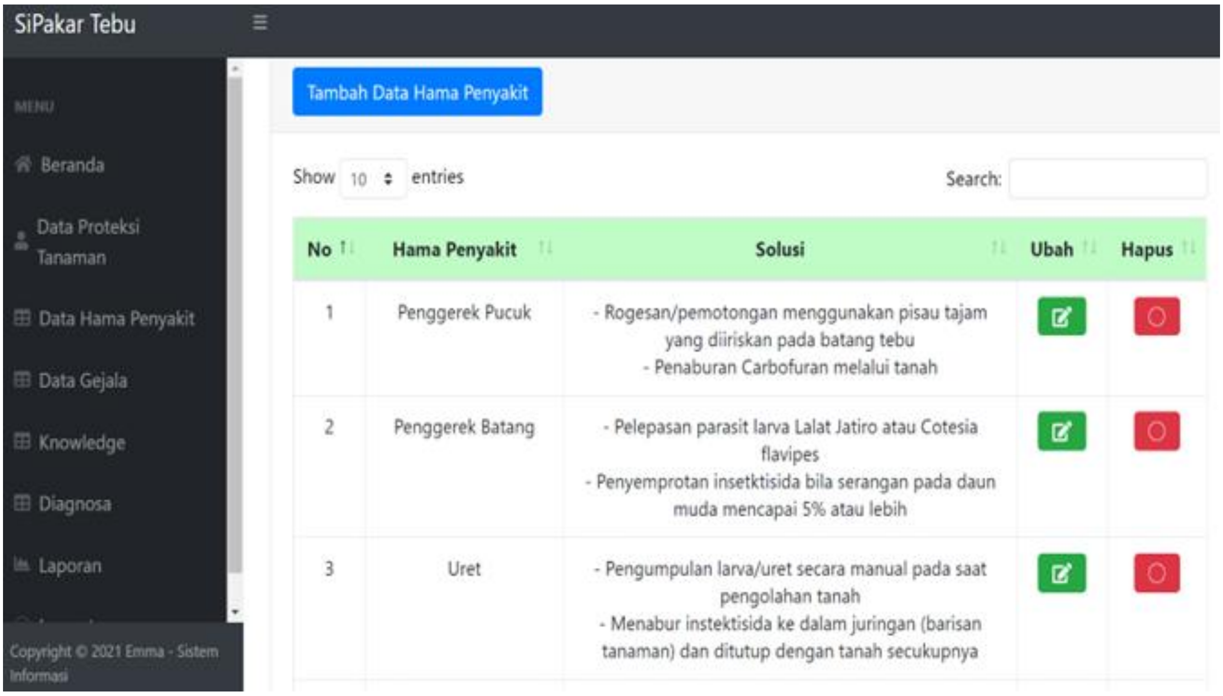
Masukkan password

Figure 2. Login Page



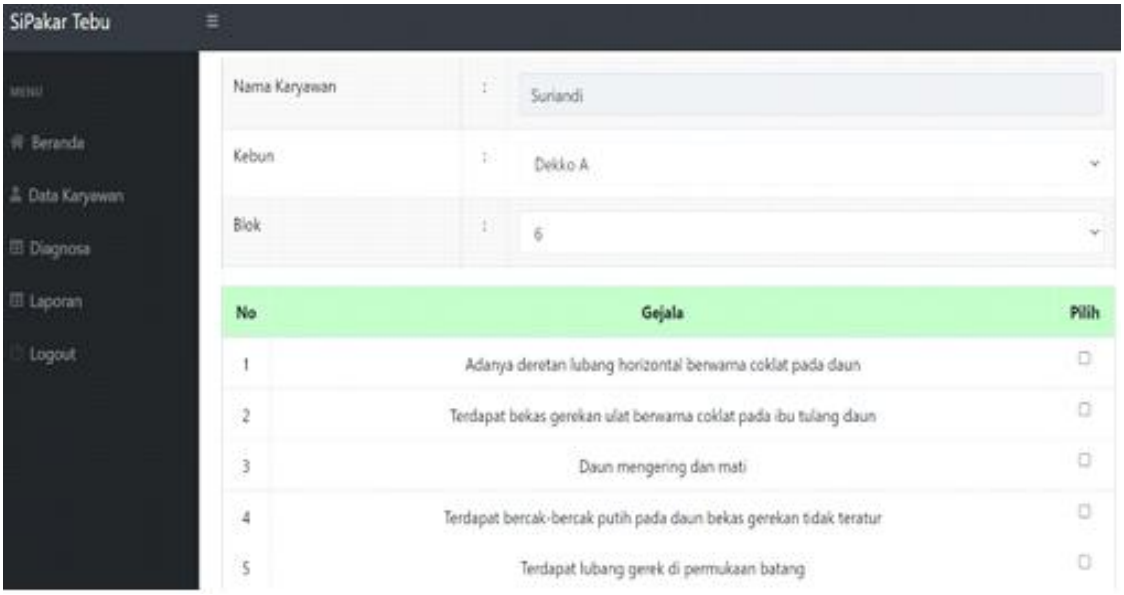
No	Kode Gejala	Gejala	Ubah	Hapus
1	G0001	Adanya deretan lubang horizontal berwarna coklat pada daun	✎	ⓘ
2	G0002	Terdapat bekas gerekan ulat berwarna coklat pada ibu tulang daun	✎	ⓘ
3	G0003	Daun mengering dan mati	✎	ⓘ
4	G0004	Terdapat bercak-bercak putih pada daun bekas gerekan tidak teratur	✎	ⓘ

Figure 3. Symptom Data Display Page



No	Hama Penyakit	Solusi	Ubah	Hapus
1	Penggerek Pucuk	- Rogesan/pemotongan menggunakan pisau tajam yang diiriskan pada batang tebu - Penaburan Carbofuran melalui tanah		
2	Penggerek Batang	- Pelepasan parasit larva Lalat Jatiro atau Cotesia flavipes - Penyemprotan insetktisida bila serangan pada daun muda mencapai 5% atau lebih		
3	Uret	- Pengumpulan larva/uret secara manual pada saat pengolahan tanah - Menabur instektisida ke dalam juringan (barisan tanaman) dan ditutup dengan tanah secukupnya		

Figure 4. Expert Page



Nama Karyawan : Suriandi

Kebun : Dekko A

Blok : 6

No	Gejala	Pilih
1	Adanya deretan lubang horizontal berwarna coklat pada daun	☐
2	Terdapat bekas gerekan ulat berwarna coklat pada ibu tulang daun	☐
3	Daun mengering dan mati	☐
4	Terdapat bercak-bercak putih pada daun bekas gerekan tidak teratur	☐
5	Terdapat lubang gerek di permukaan batang	☐

Figure 5. Diagnosis Page

3.5. System Maintenance

The maintenance system that is carried out is : (1) Corrective maintenance, in this case, a coding check is carried out to fix problems in the expert system for diagnosing sugarcane pests and diseases [10]; (2) Adaptive maintenance, to make a system more comfortable to use by the user, adjustments are made to the functions so that it is easier to use. The interface that is displayed to the user uses components and functions that are easy to understand [11].

The percentage of each answer is searched based on the data from the questionnaire with the following formula:

$$Y = P/Q \text{ x}100 \;.......(1)$$

Information:

Y: Percentage value

Q: The number of respondents for each question

Q: Number of respondents

Eligibility categories based on intervals in the following Table 8.

Table 8. Pest and Disease Data Menu Testing

Classification	Percentage Value
Very Worthy	81%-100%
Worthy	61%-80%
Enough	41%-60%
No Screen	21%-40%
Very Inappropriate	0%-20%

Result:

$$Y = \frac{94+82+84+84+92+92+84+90+84+88+88+94+86+84+84}{10} x\,100$$

$$Y = \frac{1310}{15} x100$$

Y = 87,33%

4. Conclusion

Based on the results of the design and testing of an expert system for diagnosing sugarcane pests and diseases using Case Based Reasoning and the K-Nearest Neighbor algorithm, the following conclusions can be drawn: The Case Based Reasoning method, which employs the K-Nearest Neighbor algorithm, can be used to diagnose sugarcane pests and diseases in an expert system and has been found to work properly, be simple to use, aid in the diagnosis process, and has passed the questionnaire testing phase with ten respondents. receive an average percentage of 87.33% when the category very suitable for use is included. Application of Case Based Reasoning using the K-Nearest Neighbor algorithm on an expert system for diagnosing sugarcane pests and diseases capable of displaying diagnostic results in the form of the name of the disease and its control solution based on the selected symptoms and obtaining a system accuracy of 96% from 50 cases tested.

References

[1] M. W. Astuti, H. A. Mumtahana, and R. Pamungkas, “Aplikasi Monitoring Kinerja" WORM-APP" untuk Dosen dan Karyawan (Studi Kasus: Universitas PGRI Madium),” J. IT, vol. 12, no. 2, pp. 78–89, 2021.

[2] H. Suyono, “Belajar dan pembelajaran,” Bandung: Remaja Rosdakarya, 2011.

[3] I. Khasanah, G. Raynanda, and P. R. A. Adhi, “Penerapan Metode Extreme Programming untuk Membangun Sistem Monitoring Lembaga Penelitian dan Pengabdian Masyarakat Palcomtech,” vol. 12, no. 02, pp. 175–186, 2022.

[4] Q. Lu, U. Hasson, and K. A. Norman, “A neural network model of when to retrieve and encode episodic memories,” Elife, vol. 11, p. e74445, 2022.

[5] T.-D. Bui, J.-W. Tseng, M.-L. Tseng, and M. K. Lim, “Opportunities and challenges for solid waste reuse and recycling in emerging economies: A hybrid analysis,” Resour. Conserv. Recycl., vol. 177, p. 105968, 2022.

[6] A. Wang et al., “REVISE: A tool for measuring and mitigating bias in visual datasets,” Int. J. Comput. Vis., pp. 1–21, 2022.

[7] A. Korsunova, M. Halme, A. Kourula, J. Levänen, and M. Lima-Toivanen, “Necessity-driven circular economy in low-income contexts: How informal sector practices retain value for circularity,” Glob. Environ. Chang., vol. 76, p. 102573, 2022.

[8] M. Arifin, F. Ariyana, and A. Widodo, “Testing of Integrated Sales Information Systems On UD. Remaja Bumi Raya Based on Black Box Testing with Equivalence Partitioning Method,” J. Softw. Eng. Ampera, vol. 3, no. 2, pp. 74–83, 2022.

[9] D. Marijan and C. Lal, “Blockchain verification and validation: Techniques, challenges, and research directions,” Comput. Sci. Rev., vol. 45, p. 100492, 2022.

[10] D. J. Weeks and F. Leite, “Minimizing facility corrective maintenance: Benchmarking preventative-to-corrective maintenance ratios using maintenance data and building age in dormitories,” J. Manag. Eng., vol. 38, no. 1, p. 4021086, 2022.

[11] J.-F. Zhang et al., “A Trade-Off for Maintenance of Multidrug-Resistant IncHI2 Plasmids in Salmonella enterica Serovar Typhimurium through Adaptive Evolution,” Msystems, pp. e00248-22, 2022.