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K-Nearest Neighbor (K-NN) Method for Disturbance Classification of Customer Wifi Networks at PT. Global Karya Wanda

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Abstract

This study aims to develop and implement a Wi-Fi network disturbance classification system using the K-Nearest Neighbor (K-NN) algorithm at PT. Global Karya Wanda. The purpose of this research is to identify and classify Wi-Fi network conditions based on standard categories such as interference, troubleshooting, disconnection, and signal loss, thereby improving the efficiency and accuracy of network monitoring. The system was designed and developed using PHP and MySQL, with datasets obtained from PT. Global Karya Wanda's operational network records. The classification process employed the K-NN algorithm to distinguish between Disturbance and Not Disturbance network states. The experimental results demonstrate that the K-NN method provides fast, automatic, and accurate classification performance, supporting the company in optimizing its troubleshooting workflow and enhancing customer service reliability. From a practical standpoint, the model enables more systematic network performance monitoring and proactive disturbance management. Scientifically, this research contributes to the application of machine learning algorithms in network performance analysis and telecommunications service optimization. Future studies are recommended to integrate hybrid approaches such as KNN–SVM or machine learning API integration to improve classification accuracy, scalability, and real-time responsiveness in larger and more dynamic network environments.

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1. Introduction

As time goes by, eras also change. The past and present certainly have differences and changes. Whether in terms of technology, manners or even mindset, humans will always think about their survival, they will continue to improve their performance in life, looking for ways to make it easier for them to carry out daily activities. So many discoveries that make it easier for humans to carry out their activities, starting from the emergence of technological tools such as the telecommunications industry is experiencing very rapid development, thus creating new opportunities and challenges for telecommunications service providers and infrastructure.

PT. Global Karya Wanda is an Internet Service Provider (ISP) located at Jl. Mandau No. 13, Pulo Brayan Darat II, Medan Timur District, Medan City. PT Global Karya Wanda is a privately owned company responsible for the MyIcon+ network in Indonesia. Structurally, this company has a parent company spread across Indonesia called I-Connect Region and Distribution, which is responsible for network service area offices and network service units. The company has several partners, one of which is responsible for handling outages.

Currently, PT. Global Karya Wanda's fiber optic network has been deployed to customers' homes, known as Fiber To The Home (FTTH). This network is used to support Indihome and Wifi.id services. Wifi.id is a public internet service, unlike MyIcon+, which serves individual customers. This internet service provides internet connections to many customers (in public areas), making it crucial to maintain internet connection availability. Therefore, if there is a disruption to the Wifi.id network, it must be repaired immediately so that the downtime is not too long.

As time goes by, there are quite a lot of customer complaints on the MyIcon+ application, one of the applications used for customer wifi network disruption services at PT. Global Karya Wanda, who want to decide to stop using the service by choosing to use other services for reasons of service quality, namely frequent disruptions to customer internet links, it greatly impacts the quality and trust of customers, resulting in losses for PT. Global Karya Wanda, therefore PT. Global Karya Wanda needs to anticipate service termination carried out by customers due to service disruptions that occur, namely by predicting internet link disruptions that can result in customers wanting to avoid disruptions. Behind that, the customer wifi network disruption recording system is still manual so that in processing customer wifi network disruption data it is late and less efficient.

To overcome the above problems, a wifi network interference classification system is needed using K-Nearest Neighbor (K-NN). K-Nearest Neighbor (K-NN) is a method based on the nearest neighbor classified against new objects. K-nearest neighbor is included in the supervised learning algorithm, the k-nearest neighbor category is classified from the majority based on the new query instance. The resulting class of the classification is used as the most frequently appearing class. K-NN is a lazy learning method where the model is learned from no testing data, only learning from classification test examples. The k-nearest neighbor method aims to attribute and training data based on classified objects.

2. Research Methodolgy

This research will use data collection methods such as reference studies, interviews, and documentation. The explanations are as follows:

a. Field Method
   Data collection is conducted by directly observing the research object and observing how WiFi network disruption occurs at the research location.
b. Library Method
   Data collection is conducted from books, journals, reports, and other written sources related to the research problem, including research related to "Application of the K-Nearest Neighbors (KNN) Method for Classifying Customer WiFi Network Disruptions (Case Study: PT. Global Karya Wanda)".
c. Interview Method
   An interview is a purposeful conversation. The conversation is conducted by two parties: the interviewer who asks questions and the interviewee who provides answers. The main characteristic of an interview is direct, face-to-face contact between the information seeker and the information source.

This research involved conducting a study on the application of the K-Nearest Neighbors (KNN) method for classifying customer Wi-Fi network disturbances (Case Study: PT. Global Karya Wanda). The research methodology encompasses the procedures and steps required to achieve the design objectives. These steps are:

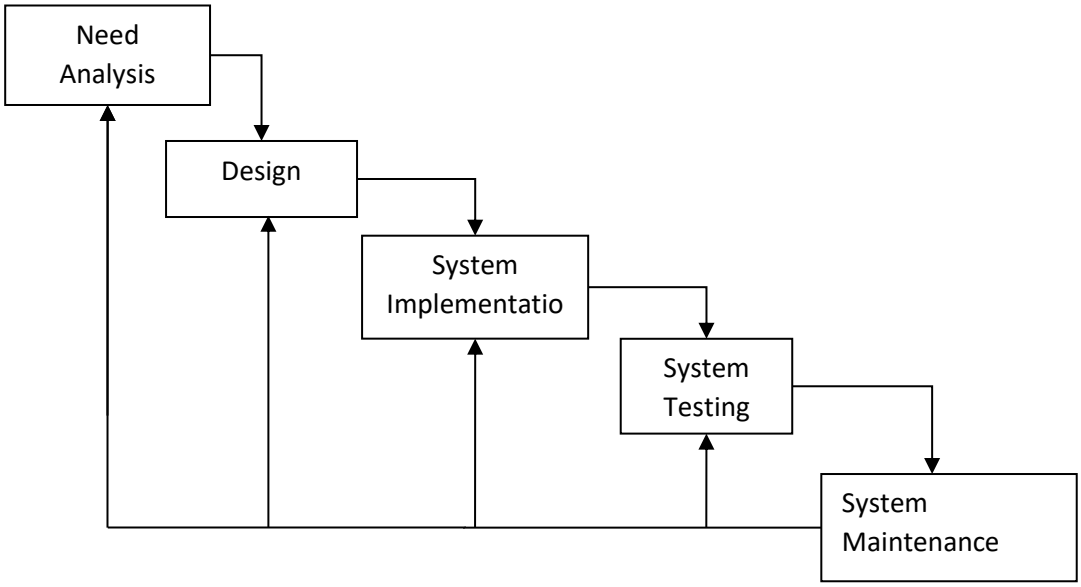

Figure 1 Research Method

1. Needs Analysis

In this analysis stage, the requirements needed to design the Application of the K-Nearest Neighbors (KNN) Method for Classifying Customer Wi-Fi Network Interference (Case Study: PT. Global Karya Wanda) are identified.

2. Design

The design stages carried out in creating the system and application to be designed by the author are:

a. Designing the system using UML (Unified Modeling Language).
b. Using Visual Studio Code to design the application.
c. Using Visio to draw the system flowchart.

3. System Implementation

To be understood by a computer or PC, the design must be transformed into a form that can be understood by a computer or PC, namely through a coding process, which is a form of programming language. The implementation stage is the application of the system design stage.

4. System Testing

After the designed system has been implemented into an application, the next stage is testing, starting with specifications, design, and coding. In this study, system testing was conducted through black-box testing of all application functions. Black-box testing is a type of application or software testing that focuses on the functional requirements of the software.

5. System Maintenance

During implementation, errors may still occur that were not previously discovered, or new features may be added that were not yet available in the system. Development is necessary when changes are made to the system to make it easier to understand, or when problems arise when the application is being used.

3. Results and Discussion

To date, PT Global Karya Wanda has used the MyIcon+ app to coordinate Wi-Fi network disturbance reports. MyIcon+ is a mobile application developed by PT Indonesia Comnets Plus (Icon+), a subsidiary

of PLN, to provide digital services for its customers and business partners. The app is designed to facilitate customer access to various services related to internet networks and telecommunications infrastructure.

MyIcon+ is one of the applications used for customer wifi network Disturbance complaint services at PT. Global Karya Wanda. Admin officers will share all Disturbance numbers (commonly called "tickets") into the MyIcon+ application. After that, the technician chats to confirm the retrieval of the Disturbance number (ticket) that will be handled. The use of the MyIcon+ application certainly has weaknesses, namely following the application owner's format and not the summary of wifi network Disturbance reports that are still computerized using excel, so that technician data and wifi network Disturbance data are input using excel when the technician finishes repairing wifi Disturbance, the time of retrieval and the time of completion of handling Not documented in the company system officially (formally). Reporting wifi network Disturbance data in response time and handling time (recovery time) has an impact on the bad image of PT. Global Karya Wanda in the eyes of customers due to the performance of subsidiaries in providing technical handling of wifi network Disturbance Not in accordance with the standards set by PT. Global Karya Wanda.

Disturbance classification is conducted so that the company can understand frequently occurring disturbance patterns and their impact on customer decisions, whether they will continue using the service or discontinue use. With this classification, PT. Global Karya Wanda can more quickly take corrective action against types of disturbances that have the potential to cause customer non-disturbance. Furthermore, the results of this classification can serve as a basis for improving service quality by focusing more on addressing the most frequent types of disturbances.

Customers play a crucial role in reporting network disturbances through the MyIcon+ application provided by PT. Global Karya Wanda. They can report issues they encounter, provide feedback on disturbance management, and assist the company in identifying frequent network issues. Furthermore, data collected from customers in the form of Excel files is also a primary source in the classification process using the KNN method. The KNN method offers several advantages, including simple training, speed, ease of understanding, and effectiveness when training data is large.

A.Application of the K-Nearest Neighbor (K-NN) Method

Steps in the K-Nearest Neighbor (K-NN) Method:

1. Determine the parameter K, where K = the number of nearest neighbors.
2. Calculate the distance between the new data and all training data.
3. Sort the distances and determine the nearest neighbor based on the minimum of K.
4. Examine the class of the nearest neighbor.

The following explains the variable for the underprivileged population:

Table 1 Table of Types of Disturbances

Kode	Disorder Name
A01	Interference
A02	WiFi Troubleshooting
A03	WiFi Drops and Reconnects
A04	Loss of Connection

The table of disturbance types is explained as follows:

a. Interference Disturbance

The higher the community's Interference Disturbance, the lower the Interference Disturbance level. The Interference Disturbance values can be seen in Table 2:

Table 2. Interference Disturbances

Interference	Mark	Information
Co-channel	4	Two or more WiFi networks are using the same channel, causing signal overlap
Adjacent-channel interference:	3	Devices using adjacent channels

Interference	Mark	Information
Interference from other electronic devices	2	Other electronic devices, such as microwaves, cordless phones, and Bluetooth devices, can interfere with WiFi signals.
Adjacent-channel interference (ACI)	1	Occurs when a WiFi device transmits on a nearby channel.

b. WiFi Troubleshooting

WiFi Troubleshooting is a variable that can be used to track WiFi troubleshooting received each month. WiFi troubleshooting can be seen in Table III.3 below:

Table 3. WiFi Troubleshooting

Wifi Trobleshooting	Nilai	Keterangan
No Internet Access at a Specific Point *1)*	1	The first problem is that the device cannot connect to the internet because the WiFi signal coverage is poor, or even no signal at all.
User Device Cannot Connect to WiFi	2	If only one device cannot connect, the problem could be with the device itself
No Devices Can Connect to WiFi *2)*	3	This could be caused by a problem with the router, access point, or WiFi signal booster.
WiFi SSID Not Detected	4	The connection drops, and the SSID or WiFi network name doesn't appear in the list of signals. What's going on?
Network Connected, but No Internet (Limited) *3)*	5	A limited connection means your device doesn't have a valid IP address.
WiFi Router Frequently Having Problems	6	It could be that your office network equipment is outdated. Contact your ISP immediately to replace the old equipment.

c. WiFi Intermittent Connections

WiFi Intermittent Connections is a variable that can determine daily WiFi Intermittent Connections. WiFi Intermittent Connections can be seen in Table 4:

Table 4. WiFi Intermittent Connection

WiFi keeps disconnecting	Mark
WiFi Devices Too Far Away	1
Crowded WiFi Devices	2
Damaged Router	3
Environmental Obstructions	4
Poor Home Internet Provider WiFi Signal	5

d. Loss Interference

Loss Interference is a variable that determines the loss interference received each month. Loss Interference can be seen in 5:

Table 5. Loss Disturbances

Loss Disturbances	Mark
Interference from your internet service provider (ISP)	7
Router configuration issues	6
Electromagnetic interference	5
External network interference	4
Outdated or damaged devices	3
Modem problems	2
Power outages	1

For example, take several problems that will result in customers stopping subscribing and not being able to interrupt or not being able to.

Table 6. Data on Customer WiFi Interference

NP	GI	WT	WPN	GL
A	Adjacent-channel interference (ACI)	User Device Cannot Connect to WiFi	Poor Home Internet Provider WiFi Signal	Problems with router configuration
B	Adjacent-channel interference (ACI)	No Device Can Connect to WiFi	Damaged Router	Problems with router configuration
C	Adjacent-channel interference (ACI)	User Device Cannot Connect to WiFi	Poor Home Internet Provider WiFi Signal	Problems with modem device
D	Adjacent-channel interference (ACI)	No Internet Access at Specific Point	Damaged Router	Electromagnetic interference
E	Adjacent-channel interference (ACI)	WiFi SSID Not Detected	*Poor Home Internet Provider WiFi Signal*	Outdated or damaged device
F	Interference from other electronic devices	No Internet Access at Specific Point	Damaged Devices Using WiFi	Outdated or damaged device

B. Test Data

At this stage, the author entered the test data that had been recorded at PT. Global Karya Wanda using the calculation formula and the predetermined steps. The following is the data for the disturbance variable values.

Table 7. Data on WiFi Network Interference Variable Values

No	Np	Gi	Wt	Wpn	Gl
1	Nasir	3	2	5	6
2	Tukimin	1	3	3	6
3	Sairudin Salim	1	2	5	2
4	Amat Sainik	3	1	3	5
5	Pendi	3	4	5	3
6	Endang	2	1	2	3
7	Seno	1	4	3	5
8	Rizal Sitepu	3	4	4	4
9	Joko Prayetno	1	4	5	2
10	Pendi	3	2	4	4
⋮	⋮	⋮	⋮	⋮	⋮
91	Surtinem	2	4	5	7

No	Np	Gi	Wt	Wpn	Gl
92	Ruwatik	3	3	3	6
93	Rasmik	2	1	4	6
94	Bahtiar	2	1	4	5
95	Samsiyah	1	4	5	1
96	Siman	2	2	5	5
97	Rudi Harto	2	2	4	6
98	Suheri	3	1	2	3

Description:
NP = Customer Name
GI = Interference
WT = WiFi Troubleshooting
WPN = WiFi On-Off
GL = Loss Interference
The solution steps are as follows:
1. Determine the parameter K = the number of nearest neighbors (for example, set K = 3).
2. Calculate the distance between the new data and all training data using the formula

$$d(a_r, b_r) = \sqrt{\sum_{r=1}^{n} (a_r, b_r)^2} \quad (1)$$

Table 8 Distance Between New Data and All Training Data

NP	SQUARE OF DISTANCE WITH NEW DATA (3,2,4,5)
[NASIR]	= √(3-3)²+(2-2)²+(5-4)²+(6-5)² = √(0)²+(0)²+(1)²+(1)² = √0+0+1+1 = √2 = 1.41
[TUKIMIN]	= √(1-3)²+(3-2)²+(3-4)²+(6-5)² = √(-2)²+(1)²+(-1)²+(1)² = √4+1+1+1 = √7 = 2.65
[SAIRUDIN SALIM]	= √(1-3)² + (2-2)² + (5-4)² + (2-5)² = √(-2)² + (0)² + (1)² + (-3)² = √4 + 0 + 1 + 9 = √14 = 3.74
[AMAT SAINIK]	= √(3-3)²+(1-2)²+(3-4)²+(5-5)² = √(0)²+(-1)²+(-1)²+(0)² = √0+1+1+0 = √2 = 1.41
[PENDI]	= √(3-3)²+(4-2)²+(5-4)²+(3-5)² = √(0)²+(2)²+(1)²+(-2)² = √0+4+1+4 = √9 = 3
[ENDANG]	= √(2-3)²+(1-2)²+(2-4)²+(3-5)² = √(-1)²+(-1)²+(-2)²+(-2)² = √1+1+4+4

NP	SQUARE OF DISTANCE WITH NEW DATA (3,2,4,5)
	$= \sqrt{10}$
	$= 3.16$
	$= \sqrt{(1-3)^2+(4-2)^2+(3-4)^2+(5-5)^2}$
[SENO]	$= \sqrt{(-2)^2+(2)^2+(-1)^2+(0)^2}$
	$= \sqrt{4+4+1+0}$
	$= \sqrt{9}$
	$= 3$
	$= \sqrt{(3-3)^2+(4-2)^2+(4-4)^2+(4-5)^2}$
[RIZAL SITEPU]	$= \sqrt{(0)^2+(2)^2+(0)^2+(-1)^2}$
	$= \sqrt{0+4+0+1}$
	$= \sqrt{5}$
	$= 2.24$
	$= \sqrt{(1-3)^2+(4-2)^2+(5-4)^2+(2-5)^2}$
[JOKO PRAYETNO]	$= \sqrt{(-2)^2+(2)^2+(1)^2+(-3)^2}$
	$= \sqrt{4+4+1+9}$
	$= \sqrt{18}$
	$= 4.24$
	$= \sqrt{(2-3)^2 + (1-2)^2 + (4-4)^2 + (6-5)^2}$
[RASMIK]	$= \sqrt{(-1)^2 + (-1)^2 + (0)^2 + (1)^2}$
	$= \sqrt{1 + 1 + 0 + 1}$
	$= \sqrt{3}$
	$= 1.73$
	$= \sqrt{(2-3)^2 + (1-2)^2 + (4-4)^2 + (5-5)^2}$
[BAHTIAR]	$= \sqrt{(-1)^2 + (-1)^2 + (0)^2 + (0)^2}$
	$= \sqrt{1 + 1 + 0 + 0}$
	$= \sqrt{2}$
	$= 1.41$
	$= \sqrt{(1-3)^2 + (4-2)^2 + (5-4)^2 + (1-5)^2}$
[SAMSIYAH]	$= \sqrt{(-2)^2 + (2)^2 + (1)^2 + (-4)^2}$
	$= \sqrt{4 + 4 + 1 + 16}$
	$= \sqrt{25}$
	$= 5$
	$= \sqrt{(2-3)^2 + (2-2)^2 + (5-4)^2 + (5-5)^2}$
[SIMAN]	$= \sqrt{(-1)^2 + (0)^2 + (1)^2 + (0)^2}$
	$= \sqrt{1 + 0 + 1 + 0}$
	$= \sqrt{2}$
	$= 1.41$
	$= \sqrt{(2-3)^2 + (2-2)^2 + (4-4)^2 + (6-5)^2}$
[RUDI HARTO]	$= \sqrt{(-1)^2 + (0)^2 + (0)^2 + (1)^2}$
	$= \sqrt{1 + 0 + 0 + 1}$
	$= \sqrt{2}$
	$= 1.41$
	$= \sqrt{(3-3)^2+(2-2)^2+(4-4)^2+(5-5)^2}$
[SUHERI]	$= \sqrt{(0)^2+(0)^2+(0)^2+(0)^2}$
	$= \sqrt{0+0+0+0}$
	$= \sqrt{0}$
	$= 0$

1. Sort the distances and assign the nearest neighbors based on the minimum distance to – K=3:

Table 9 Determination of Nearest Neighbor Classification (K = 3)

No	Customer No	Name	Distance	Rating	Including K Nearest	Classification
1	P030	DARJAK	0	1	Ya	Disturbance
2	P010	PENDI	1	2	Ya	Disturbance
3	P038	SIRIN	1	3	Ya	Disturbance
4	P001	NASIR	1.41	4	Ya	Disturbance
5	P004	AMAT SAINIK	1.41	5	Ya	Disturbance
6	P012	LEGIMAN	1.41	6	Ya	Disturbance
7	P036	MULYONO	1.41	7	Ya	Disturbance
8	P048	MAMIN	1.41	8	Ya	Disturbance
9	P094	BAHTIAR	1.41	9	Ya	Disturbance
10	P096	SIMAN	1.41	10	Ya	Disturbance
⋮	⋮	⋮	⋮	⋮	⋮	⋮
91	P050	ATAN PURBA	3.74	91	Not	Not Disturbance
92	P021	SAYUDI	3.87	92	Not	Not Disturbance
93	P046	SUYITNO	4	93	Not	Not Disturbance
94	P064	LASIMAN	4	94	Not	Not Disturbance
95	P009	JOKO PRAYETNO	4.24	95	Not	Not Disturbance
96	P056	YAHYA	4.24	96	Not	Not Disturbance
97	P095	SAMSIYAH	5	97	Not	Not Disturbance

From the initial research data used, 98 customers were identified, including 35 Not Disturbance customers and 62 Disturbance customers. Therefore, the classification results show that Endang to Syamsiah are Not Disturbance customers, while Darjak to Parmi are Disturbance customers.

4. Conclusion

Based on the research conducted, it can be concluded that the implementation of the K-Nearest Neighbor (K-NN) algorithm for classifying Wi-Fi network disturbances at PT. Global Karya Wanda has proven to be effective in identifying and categorizing network issues accurately and efficiently. The developed system, built using PHP and MySQL, successfully classified customer Wi-Fi network conditions into two categories—Disturbance and Not Disturbance—based on parameters such as interference, Wi-Fi troubleshooting, intermittent connection, and loss of connection. The classification results demonstrate that the K-NN method provides fast and reliable outcomes, thereby assisting the company in improving response times, identifying recurring disturbance patterns, and enhancing customer service quality. From a practical perspective, the system enables PT. Global Karya Wanda to monitor network performance more systematically and anticipate service disruptions that may lead to customer dissatisfaction or service termination. The implementation of this classification model contributes to optimizing network maintenance processes and improving decision-making in handling technical disturbances.Scientifically, this study contributes to the application of machine learning techniques, particularly K-NN, in the field of network management and telecommunications service optimization. The research highlights the algorithm's potential for real-world problem-solving, especially in automating classification tasks using structured operational data. For future research, it is recommended to enhance this model by integrating hybrid classification approaches such as KNN–SVM or KNN–Decision Tree to achieve higher accuracy and adaptability. In addition, connecting the system to machine learning APIs or deploying it on cloud-based platforms could enable real-time classification and scalability for larger network datasets. Expanding the dataset with temporal and environmental parameters may also improve the robustness and generalization capability of the model in more dynamic network environments.

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