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Geographic information system for reporting damage and road grouping based on website using waterfall method and k-means method

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Abstract: Roads are a vital land transportation infrastructure and transportation route. One of the functions of roads is as a driving factor in the development process and equitable distribution of development in a region. Road damage that occurs disrupts the activities and routines of residents. Lhokseumawe City as the center of economic and social development in its region requires an efficient system for the management and maintenance of road infrastructure. The reason is that many road damages occur in Lhokseumawe City that have not been repaired due to limited damage information so reports are needed from residents to find out the location of the road damage so that it is easier for the Lhokseumawe City government to follow up on the report. With these problems, a geographic information system for reporting road damage is created. It is hoped that the government can follow up on the report and prioritize damage with the highest group, which groups road damage using the clustering method. This web-based information system is designed using the UML (Unified Modeling Language) model with the PHP programming language and uses MySQL as its database. With this system, the government can receive reports of existing damage and group the damage into three levels to determine the priority of road repairs to be carried out.

Keywords: *Geographic information system, K-means, Road, UML, Waterfall.*

1. Introduction

The origin of the word Lhokseumawe is "Lhok" and "Seumawe". Lhok means deep, bay, sea trough and Seumawe means swirling air or the center and spring of the sea along the coast off Banda Sakti and its surroundings. Other information also states that the name Lhokseumawe comes from the name Teungku, namely Teungku Lhokseumawe [1], buried in Uteun Bayi village, the oldest village in Banda Sakti District. Lhokseumawe City is located between 4° - 5° North Latitude and 96° - 97° East Longitude with an average height of 13 meters above sea level. The boundaries of Lhokseumawe City, to the north bordering the Malacca Strait, to the south with Kuta Makmur District (North Aceh), to the east with Syamtalira Bayu District (North Aceh), and to the west with Dewantara District (North Aceh)[2]. The area of Lhokseumawe City is 181.06 km2, 60% of the area of Lhokseumawe City is a residential area where the population of Lhokseumawe City in 2016 was 195,186 people [3] [4].

Road damage in Lhokseumawe City affects the safety and comfort of road users [4]. Factors such as the type of material, road surface structure, unstable ground conditions, poor compaction processes on the soil layer, excessive vehicle capacity, and excessive vehicle loads can cause damage to roads [5]. There are two main types of damage, namely structural damage and functional damage [6][7]. Structural damage occurs when one or more parts of the road pavement are damaged so that the

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pavement is no longer able to withstand traffic loads properly. However, functional damage is damage that disrupts the safety and comfort of road users, resulting in increased vehicle operating costs [8].

Adequate road network infrastructure is an important asset for increasing community activities in the region, both in terms of social and economic activities [9]. Because, transportation facilities, and roads, also play a role as a means of community and accessibility. In good road conditions, economic and transportation activities also run smoothly. The importance of information media as a form and channel for delivering messages and information. Thus, in the era of rapidly developing computerization today, insight into the decision-making process for disseminating information has been opened. Information media is the most important choice for users and managers in receiving information. The large number of road damages in Lhokseumawe City today often makes it difficult for the relevant agencies to determine the priority of repairing road damage. The reason is that many complaints from the public for repairs to the road to their village only reach the village apparatus and there is no response from the agency or the information is not conveyed to the Public Works and Spatial Planning Agency so that the road is still in a damaged condition. Based on the description of the problem above, it can be concluded that a problem is where the limited information received from related parties about road damage is needed so an information system is needed for reporting road damage in the area. So based on the problems above, the researcher took the title "Geographic Information System for Reporting Road Damage in Lhokseumawe City Based on Website" With this research and information system for reporting road damage, it is hoped that it will make it easier for the public to report road damage and display visualization of the condition of the road sections in Lhokseumawe City so that it is easier for users to choose the route to be taken. This information system will later display geographic data on road damage in Lhokseumawe City which can be viewed by anyone who has an interest online.

2. Literature Review

In the modern era of digitalization, recent developments involve the use of digital maps known as Geographic Information Systems (GIS) [10]. A Geographic Information System is a computer-based system designed to collect, store, and analyze geographic information. The main focus of the Geographic Information System is to collect, store, and analyze objects and phenomena where geographic location is a critical attribute analyzed [11][12]. A Geographic Information System (GIS) is a system that captures, integrates, manipulates, analyzes, and displays data spatially (spatially) referring to the condition of the earth [13].

In general, a geographic information system (GIS) consists of human resources, software, geographic data, and hardware that work together to input, store, correct, update, manage, manipulate, integrate, analyze, and display data [14][11].

Many definitions of GIS change and vary. The following are some of the many definitions given to GIS:

1. GIS is a computer-based system that can collect, store, search, analyze, and display geographic data.
2. GIS is a computer-based system that can handle geographically referenced data, namely entering data, processing it, and displaying it. The final result can be used as a basis for geographic decision-making.
3. GIS is a system that enables spatial decision-making and can integrate location descriptions with the characteristics of phenomena that occur at that location. A complete GIS includes the necessary methodology and technology, such as spatial data hardware, software, and organizational structure.
4. GIS is a computer-based system used to enter, store, manage, analyze, and reactivate data with spatial references for various mapping and planning purposes.

A Geographic Information System (GIS) is a computer system capable of managing information that has a geographical reference. Its main functions involve data storage, data management (including storage and retrieval), data processing and analysis, and printing. The result of this process can be used as a basis for decision-making. With its extensive capabilities, GIS can be a very significant tool in supporting decision-making for sustainable development. Geographic Information System technology

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can be used for scientific investigations, resource processing, development planning, cartography, and route planning. For example, in this case, the designed GIS can display information on road damage around the Padang sidimpuan City area and create a reporting system by the community so that it can be known quickly by related parties. Spatial information systems are divided into two groups, namely manual systems (analog) and automatic systems (based on digital computers)[15]. The difference lies in their control. Manual data systems usually combine several data sets such as maps, overlays, aerial photographs, statistical reports, and field survey reports. All data is collected and analyzed manually using non-computer tools. At the same time, automated Geographic Information Systems use computers as data processing systems through the digitization process[16][17].

3. Methods

The research results that were sought were obtained through a series of phases in the data collection conducted for this study. The study was conducted in the following phases.;

1. Field Research
   The initial phase in this field research was to meet with the Public Works Department to request data on road damage in Lhokseumawe City and to compare the data with the actual conditions at the location. The objectives of the survey were met during the evaluation at the location, which included the recording of the necessary data, observations, and measurements. After the data was verified, the subsequent step was to identify any new damage data that the department had not yet identified. This was accomplished by examining the areas that were frequently traversed by road users, those that were susceptible to road damage as a result of weather conditions, and the roads that were frequently traversed by vehicles carrying large loads.
2. *Interview*
   Field research involved conducting multiple question-and-answer sessions with neighbors near the damaged route to gather essential information. Additionally, an interview was conducted with personnel from the Lhokseumawe City Public Works Department, specifically within the road and bridge maintenance and rehabilitation division of the highway construction sector, to gather information regarding the duration of road damage and any supplementary data required for data completion.
3. *Library Research*
   Despite completing field research and interviews, substantial information regarding road damage in Lhokseumawe City remains unrecorded in the agency's records. To support this research, it is essential to perform a literature review to identify reference materials through studies or relevant texts pertaining to the title, serving as a foundation for theoretical frameworks connected to the research.

3.1. System Development

The building of a geographic information system for mapping road damage in Lhokseumawe City, utilizing a website, employs the waterfall method, which consists of successive phases: needs analysis, design, programming, testing, and maintenance. In the development of this information system, it is anticipated that the system will fulfill the following needs:

1. The website is capable of transmitting road damage reports from the public to the Public Works Department of Lhokseumawe City.
2. The website is capable of displaying data and visualizations regarding road damage in Lhokseumawe City.

3.2. Use Case Diagram

The function of a use case diagram is to determine the number of users who have access to a system and the functions that are present.

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Figure 1.
Use case diagram.

In accordance with the aforementioned use case, users are restricted to viewing the primary page display, reporting road damage, and viewing a map of the distribution of road damage. Although the administrator has the ability to manage the entirety of the website, including the entry of road damage data from the agency, the viewing of reports from residents regarding road damage, and the analysis of road damage clustering to determine the agency's repair priorities, the administrator must first log in by providing a username and password in order to access these features.

3.3. Research Framework

The subsequent research framework will be executed inside the Applied Research Scheme.

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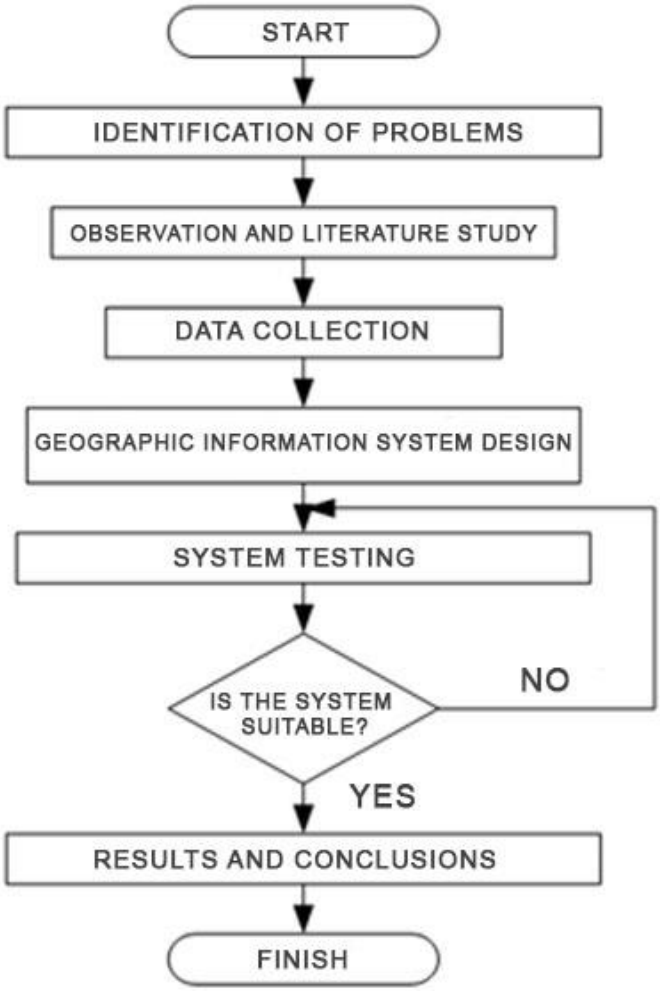

Figure 2.
Research framework.

The study on the road damage reporting system in Lhokseumawe City commenced with the identification of the problem, which disclosed the lack of an adequate system for reporting road damage. Consequently, repairs were not conducted. Additionally, the author conducted observations at the Ministry of Public Works and Public Housing of Republic of Indonesia Office of Lhokseumawe City to gather information regarding road damage, as well as tracing previous research and references from a variety of sources, including the internet and literature. The information gathered encompassed the city's road conditions and road sections. The process of designing a geographic information system commenced with the analysis of needs, the development of the system, its creation, and its implementation. The system was specifically developed to facilitate the reporting of road damage. The testing phase was conducted to verify that the system functioned in accordance with the research objectives following the design phase. If any deficiencies were identified, they were rectified until the system was error-free. Ultimately, the author concluded the research by summarizing the findings, identifying strengths and weaknesses, and offering recommendations for future research. This conclusion addressed the inquiries posed in the introduction chapter.

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4. Result and Discussion

The Department of Public Works and Spatial Planning Office of Lhokseumawe City collected a variety of data that was essential for this study, including road damage data along the city's roads. Subsequent to the acquisition of the data, an additional investigation was conducted to identify the site of the road damage. According to the office's data, there were 66 roads in Lhokseumawe City that were damaged. The road damage data that was received only included information on the condition of the road, road classification, road length, and road sections.

4.1. Interview Results

The researcher's interview with the Head of the Highways Division of the PUPR Office of Lhokseumawe City can serve as a reference to enhance the researcher's understanding in the completion of this research. During the search for road damage data, the office utilizes a data collection application that is exclusively accessible to the officers and employees of the office who are responsible for administering road data. The Public Works Office of Lhokseumawe City is responsible for the management of a variety of road damages that are classified as district or city roads. Only 475 km of road sections are classified as district/city roads, according to data published by the Lhokseumawe City Office. In each road section, there are 179.524 km of road sections that are in moderate to damaged condition. The severity of road damage in Lhokseumawe City is classified into three categories: moderate, lightly damaged, and severely damaged. These categories are determined by the type of damage, as well as the depth and extent of the damage. Road damage has never been reported in Lhokseumawe City. The data collection application owned by the Lhokseumawe City Public Works and Spatial Planning Service is typically used to collect damage data from road survey activities that are conducted on a monthly basis by road construction staff. Typically, extant road damage is recorded or known.

4.2. System Implementation

The final outcome of developing a system that generates numerous pages is the implementation of this system, The clustering results data on this page are the result of the system or website's analysis of the width, area, and form of road damage data. The road damage cluster is further divided into three clusters: severe damage, moderate damage, and mild damage.

4.3. Manual Calculation of K-Means

Manual calculations were implemented to evaluate the phases of the UI test calculation on the program. The objective is to ascertain whether the results of the system's calculations are identical to those of manual calculations. The manual calculation process in the city of Lhokseumawe, which utilizes road damage data, is illustrated below:

4.4. Iteration Process

Calculating the distance between the centroid center and the data using the Euclidean Distance formula. The algorithmic calculation of the distance between randomly selected cluster centers.
Euclidean Distance Formula

$$d(x,y) = \sqrt{(x_1 - y_1)^2 + (x_2 - y_2)^2 + \cdots + (x_m - y_n)^2} \qquad (1)$$

The implementation of k-means within the system is illustrated in the subsequent flow:

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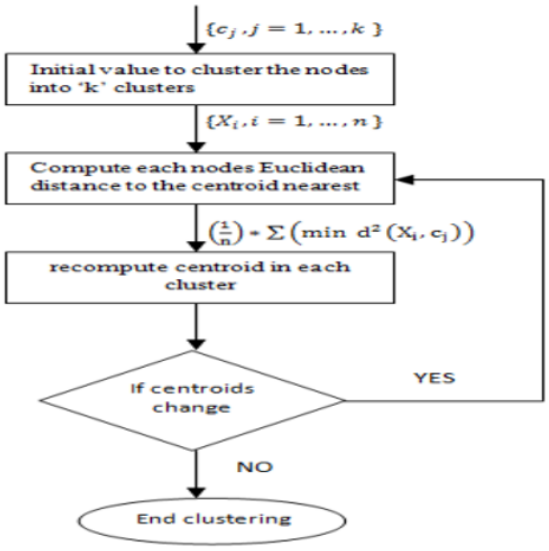

Algorithm 1: K-Means Clustering

Input: $X = \{x_1, x_2, \ldots, x_n\}$ (set of nodes to be clustered)
k (number of clusters)

Output :
$C = \{c_1, c_2, \ldots, c_k\}$ (set of cluster centroids)

Initialization
for each $c_i \in C$ *do*
$c_i \leftarrow x_j \in X$ *(random selection)*
end
repeat
for each $x_i \in X$ *do*
$minDist \leftarrow minDistance\ x_i, c_j \quad j \in 1 \ldots k$;
(based on Euclidean distance $\frac{1}{n} * \min_j d^2\ X_i, c_j$, for i = 1 to n,)

UpdateCluster(c_i)
end
until convergence

Figure 4.
Flowchart of K-means algorithm and k-means clustering algorithm.

The distance between the data and the centroid center from the second iteration is determined using the new centroid value. The distance is determined by employing the Euclidian distance formula and the new centroid value. The results of this calculation are presented in the table below:

Table 1.
Data distance table with centroid iteration II.

Data	Distance C1	Distance C2	Distance C3	Minimum distance	Cluster
1	2.733018067	1.285137154	1.436140662	1.285137	2
2	4.297602559	2.677703498	0.75	0.75	3
3	4.297602559	2.677703498	0.75	0.75	3
4	2.958902168	1.327662839	0.75	0.75	3
5	1.743793659	0.596054701	2.136000936	0.596055	2
6	2.457807219	1.064452434	1.600781059	1.064452	2
7	2.733018067	1.285137154	1.436140662	1.285137	2
8	2.398979375	0.992426741	1.600781059	0.992427	2
9	3.469987943	1.968197075	1.030776406	1.030776	3
10	2.114092655	0.934772553	2.015564437	0.934773	2
11	1.525296893	1.313640582	2.926174978	1.313641	2
12	1.324802642	0.494135706	2.46221445	0.494136	2
13	1.324802642	0.494135706	2.46221445	0.494136	2
14	0.202030509	1.684269185	3.75	0.202031	1
15	0.202030509	1.684269185	3.75	0.202031	1
16	1.743793659	0.596054701	2.136000936	0.596055	2
17	1.324802642	0.494135706	2.46221445	0.494136	2
18	1.324802642	0.494135706	2.46221445	0.494136	2
19	0.202030509	1.684269185	3.75	0.202031	1
20	1.324802642	0.494135706	2.46221445	0.494136	2
21	1.743793659	0.596054701	2.136000936	0.596055	2
22	0.868966076	2.173856384	4.190763654	0.868966	1

23	2.114092655	0.934772553	2.015564437	0.934773	2
24	1.324802642	0.494135706	2.46221445	0.494136	2
25	1.324802642	0.494135706	2.46221445	0.494136	2
26	0.202030509	1.684269185	3.75	0.202031	1
27	0.202030509	1.684269185	3.75	0.202031	1
28	1.743793659	0.596054701	2.136000936	0.596055	2
29	1.743793659	0.596054701	2.136000936	0.596055	2
30	1.324802642	0.494135706	2.46221445	0.494136	2
31	2.114092655	0.934772553	2.015564437	0.934773	2
32	1.743793659	0.596054701	2.136000936	0.596055	2
33	1.743793659	0.596054701	2.136000936	0.596055	2
34	2.515259552	1.570475189	2.25	1.570475	2
35	1.571428571	1.460499567	3.092329219	1.4605	2
36	1.324802642	0.494135706	2.46221445	0.494136	2
37	1.743793659	0.596054701	2.136000936	0.596055	2
38	0.868966076	1.210946868	3.172144385	0.868966	1

Table 2.
Iteration III of the new centroid table.

Centroid Baru	Lebar	Luas	Jenis
c1	1	1,142857	1,857143
c2	2,111111	2,185185	2,444444
c3	3,5	3,5	3,25

The results are compared to those of the preceding iteration to ensure that they generate identical data. The iteration dance is terminated and the results are determined if the iteration results are identical. These are the verified data from four sub-districts that have been recorded as having excellent roads.

Table 3.
Good road data for Lhokseumawe city.

Subdistrict	Location	Address	Road conditions
Muara Satu	Batas Muara Satu dengan Krueng Geukuh	JL. Medan – Banda Aceh	Good
	Batas Muara Satu dengan Muara Dua	JL. Medan Banda Aceh	Good
	Jalan menuju kantor camat	JL. Rancong	Good
Muara Dua	Batas Muara Dua dengan Banda Sakti	JL. Medan - Banda Aceh	Good
	Batas Muara Dua dengan Blang Mangat	JL. Medan - Banda Aceh	Good
	Batas Muara Dua dengan Muara satu	JL. Medan - Banda Aceh	Good
	Jalan menuju kantor camat	JL. Teungku Wahab Dahlawi	Good
Blang Mangat	Batas Blang Mangat dgn Kec, Syamtalira (Kab. Lhoksukon)	JL. Medan - Banda Aceh	Good
	Batas Blang Mangat dgn Muara Dua	JL. Medan - Banda Aceh	Good

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	Jalan Menuju Kantor Camat Blang Mangat	JL. Medan - Banda Aceh	Good
Banda Sakti	Batas Banda Sakti dgn Muara Dua	JL. Medan - Banda Aceh	Good
	JL. Darussalam	JL. Darussalam	Good
	JL. Gudang Baru	JL. Gudang Baru	Good
	JL. Gudang III	JL, Gudang III	Good
	JL, Iskandar Muda	Jl. Iskandar Muda	Good
	JL. Listrik	JL. Listrik	Good
	JL. Merdeka	JL. Merdeka	Good
	JL. Panglateh	JL. Panglateh	Good
	JL. Pase	JL. Pase	Good
	JL. Perdagangan	JL. Perdagangan	Good
	JL. Pusong	JL. Pusong	Good
	JL. Samudera 1	JL. Samudera 1	Good
	JL. Samudera Baru	JL. Samudera Baru	Good
	JL. Teuku Hamzah	JL. Teuku Hamzah	Good
	JL. Teungku Chik Ditiro	JL. Teungku Chik	Good
	Kantor Camat Banda Sakti	JL. Darussalam	Good

In the interim, the following roads are classified as either moderately damaged or damaged:

Table 4.
Data on damaged roads in Lhokseumawe city.

Subdistrict	**Address**	**Road conditions**
Blang mangat	JL. Pendidikan Gampong Balai Peuteut	Broken
	JL. Medan – Banda Aceh Peunteut	Broken
	JL. Hakim Krueng	Broken
	JL. Krueng Pase	Broken
	JL. Madan	Broken
	JL. Meunasah	Broken
	JL. Line Pipa	Broken
Muara Dua	JL. Teungku Ahmad Kandang	Broken
	JL. Gampong Uteunkot	Broken
	JL. Tgk. Wahab Dahlawi	Broken
	JL. Abdullah Yakob	Extremely broken
	JL. Pesantren	Broken
Banda Sakti	JL. Ujong Blang	Broken
	JL. Darussalam	Extremely broken
	JL. Pusong	Broken
	JL. Perniagaan	Broken
	JL. Pase	Broken
	JL. Tando	Broken
	JL. Maharaja	Broken
	JL. Kuta Krueng	Broken
	JL. Ps Inpres	Broken
Muara Satu	JL. Cot Suwe Gampong Padang Sakti	Broken
	JL. Kampus Bukit Indah	Broken
	JL. Line Pipa	Broken

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	JL. Medan - Banda Aceh Depan Stasiun Padang Sakti	Broken
	JL. PNKA	Broken
	JL. Unimal Bukit Indah	Broken

5. Conclusion

From the results of the research that has been done, the conclusions that can be obtained are as follows:

1. The road damage reporting system that was built can be a solution for the background where there was no previous road damage reporting system.
2. The geographic information system that was built can display a map that is connected to open street maps and can display the location points of road damage reported by the public which are marked with 3 types of colors, namely: a red mark indicates that the location has a road with a condition of severe damage, a green mark indicates that the location has a road with a condition of moderate damage, and a yellow mark indicates that the location has a road with a condition of minor damage.
3. With this system, it can be used to report road damage in Lhokseumawe City which is expected to be repaired directly by the PUPR Office of Lhokseumawe City based on public reports.
4. The results of testing this system obtained good results with no error rate

References

[1] D. Abdullah, C. Ita, and M. Fikry, "Data Envelopment Analysis with Lower Bound on Input to Measure Efficiency Performance of Department in Universitas Malikussaleh," *Int. J. Artif. Intell. Res.*, vol. 4, Apr. 2020, doi: 10.29099/ijair.v4i1.164.

[2] S. Adi and A. Fathoni, "Blended Learning Analysis for Sports Schools in Indonesia," *Int. J. Interact. Mob. Technol.*, vol. 14, p. 149, Jul. 2020, doi: 10.3991/ijim.v14i12.15595.

[3] F. Hasballah, F. Fuadi, and M. Ramadhan, "Faktor-Faktor yang mempengaruhi Minat Wakaf Masyarakat di Kota Lhokseumawe," *J. EMT KITA*, vol. 3, p. 81, Nov. 2019, doi: 10.35870/emt.v3i2.111.

[4] F. Fauziah, M. Mulyadi, and A. Fata, "Sistem Informasi Geografis Letak Trafo Step-Dow Pada PT PLN (Persero) Rayon Lhokseumawe Kota Dengan Menggunakan Metode Dijikstra," *J. Teknol. Rekayasa Inf. dan Komput.*, vol. 3, no. 2, 2020.

[5] F. D. Hastuti, M. Sarma, and M. -, "STRATEGI PENINGKATAN PERTUMBUHAN EKONOMI MELALUI INVESTASI INFRASTRUKTUR JALAN DAN JEMBATAN DI PROVINSI BANTEN," *J. Manaj. Pembang. Drh.*, 2019, doi: 10.29244/jurnal_mpd.v8i1.24659.

[6] C. S. Iskandar, "Kinerja campuran beton aspal AC-WC dengan penambahan limbah botol plastik," *MACCA*, vol. 6, no. 1, 2021.

[7] A. Rahman and Z. Ardian, "APLIKASI PENCARIAN ALAMAT TUJUAN BERBASIS ANDROID (STUDI KASUS DAERAH BANDA ACEH)," *J. INFORMATICS Comput. Sci.*, vol. 4, p. 64, Dec. 2019, doi: 10.33143/jics.Vol5.Iss1.509.

[8] N. Mahbubah, A. Eka, and D. Andesta, "ANALISIS POSTUR KERJA PADA PEKERJA DI JALAN REL DENGAN PENDEKATAN METODE WERA DAN JSI," Nov. 2021, doi: 10.30587/justicb.v1i3.2623.

[9] K. Nisa and W. Budiarti, "PENGARUH TEKNOLOGI INFORMASI DAN KOMUNIKASI TERHADAP TINGKAT KEMISKINAN DI INDONESIA TAHUN 2012-2017," *Semin. Nas. Off. Stat.*, vol. 2019, pp. 759–768, May 2020, doi: 10.34123/semnasoffstat.v2019i1.186.

[10] Nurdin, M. Suhendri, Y. Afrilia, and Rizal, "Klasifikasi Karya Ilmiah (Tugas Akhir) Mahasiswa Menggunakan Metode Naive Bayes Classifier (NBC)," *Sistemasi*, vol. 10, no. 2, p. 268, 2021, doi: 10.32520/stmsi.v10i2.1193.

[11] D. K.-175410079 Khomsah, "IMPLEMENTASI LOCATION BASED SERVICE (LBS) DENGAN STUDI KASUS PENCARIAN RESTORAN McDONALD'S TERDEKAT BERBASIS ANDROID," 2021.

[12] K. Kraugusteeliana, H. Nasution, B. Triwahyono, M. Ikhwani, Z. Ardian, and A. Bintoro, "Aplikasi Pemilihan Lapangan Futsal Menggunakan Mobile-GIS dan GPS Dengan Metode Algoritma Dijkstra," *J. Inf. dan Teknol.*, pp. 59–66, Nov. 2023, doi: 10.60083/jidt.v5i4.417.

[13] D. Metode Haversine, "APLIKASI PANDUAN OBJEK WISATA ALAM GRESIK BERBASIS ANDROID

DENGAN METODE HAVERSINE," *Ubiquitous Comput. its Appl. J.*, vol. 2, no. 1, pp. 67–74, Jun. 2019, doi: 10.51804/UCAIAJ.V2I1.67-74.

[14] M. Qamal, "RANCANGAN APLIKASI ANDROID UNTUK PENCARIAN LOKASI WISATA DI KOTA BANDA ACEH," *TECHSI - J. Tek. Inform.*, vol. 11, no. 1, p. 131, May 2019, doi: 10.29103/techsi.v11i1.1387.

[15] M. Sofyan, M. Isya, and R. Anggraini, "Pemanfaatan Sistem Informasi Geografis (SIG) Untuk Prioritas Penanganan Jalan Di Kabupaten Aceh Besar," *J. Tek. Sipil Univ. Syiah Kuala*, vol. 1, 1AD.

[16] N. Nurdin, M. Suhendri, Y. Afrilia, and R. Rizal, "Klasifikasi Karya Ilmiah (Tugas Akhir) Mahasiswa Menggunakan Metode Naive Bayes Classifier (NBC)," *SISTEMASI*, vol. 10, p. 268, May 2021, doi: 10.32520/stmsi.v10i2.1193.

[17] A. Sulistiyawati and E. Supriyanto, "Implementasi Algoritma K-means Clustring dalam Penetuan Siswa Kelas Unggulan," *J. Tekno Kompak*, vol. 15, p. 25, Aug. 2021, doi: 10.33365/jtk.v15i2.1162.

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