CIVED Journal of Civil Engineering and Vocational Education

EISSN: 2622-6774
Vol 11 No.3 September 2024
http://cived.ppj.unp.ac.id/index.php/CIVED

Utilization of Open Polygon Method for Land Mapping in Mojoroto Kediri with Geospatial Approach

Ricky Eka Satria Agung Permana[1], Imam Mustofa[2*], Ismatul Putri Aprillinda[3], Zahra Purwanto[4], Muhammad Ali Muhdhor[5], Uluumul Chaq[6], Fadlila Ayub Ramadhani[7], Daniel Jalu Aufarel Wicaksono[8]

[1,2,3,4,5,6,7,8] Civil Engineering, Universitas Kadiri, Kediri, Indonesia

[*]Corresponding author, e-mail: imammustofa@unik-kediri.ac.id

Received 27th July 2024; Revision 26th August 2024; Accepted 24th September 2024

ABSTRACT

Land mapping is an important research activity to determine the location of points on the earth's surface, describing the physical condition of parts of the surface that resemble the actual condition. The objective of this process is to gain a comprehensive understanding of the land to be built and used through land area measurements, topographic maps, and land volume analysis at various altitudes. In this mapping, the open polygon method is used for calculations which are conventional methods using data point values as data centers to represent the area of influence. During this mapping, there are three main points used with the open polygon method. A total of 26 ground contours were recorded, and 4 road contours recorded. During the mapping process, corrections are required on the open polygon calculations to ensure the accuracy of the results. This correction involves adjusting the data to take into account field variability and inaccuracies of measuring instruments, so that the resulting data can be reliable for further analysis and correct decision-making. The land that has been painted can be used for various fields such as construction, and mining. Land mapping allows partial surface physical state imaging, classification of land, and can be used to plan, build, and maintain infrastructure such as highways and bridges. The result of this practice obtained data of the maximum height of 90,0945 masl and minimum 88,76 masl with the average ground height 90,05059 masl, while the average highway height is at 88,86175 masl.

Keywords: *Land Mapping; Land Area Measurements; Topographic Maps; Land Volume Analysis; Open Polygon Method*

INTRODUCTION

Soil measurement is an important activity in determining the position of the points on the earth's surface and describing the physical state of the soil accurately, as depicted in the topographic map. This activity includes a variety of simple tasks such as measuring distance, length, width, and slope of land. In addition, soil measurement plays a vital role in many engineering branches, such as the planning and maintenance of highways, bridges, and other land, with methods such as polygon mapping that gives planimetric coordinates (X,Y) [1][2]. The land that has been mapped has many benefits, including in the field of agriculture for land mapping and measurement of crop production [3]. In the field of construction, data from land mapping can be used for drainage planning and assessment of the physical condition of the drainable network as well as construction of buildings [4]. Furthermore, in the area of mining, soil mappings help in the classification of the mining area and in assessing the ecological damage and change of the mine area [5][6]. Thus, the land that has been painted is highly potential for use in housing construction, cost, and various other types of buildings.

The importance of land mapping is carried out as it is an early step in building. Information about the depth, consistency, and classification of the soil is crucial to ensuring the strength of the building foundation [7]. Physical data from the National Farming Agency and jurisdictional data from proof of land rights provide the necessary basis for effective land management [8]. However, previous land mapping was time-consuming and costly [9]. The land quality index method and the digital elevation model are important tools in assessing land quality and help in land management and infrastructure development [10][11].

The latest developments in land mapping include the use of more advanced technologies as well as the integration of more comprehensive data, such as geological mappings to identify areas vulnerable to earthquakes and hydrological maps to determine flood-sensitive areas [12]. In recent decades, technological developments have brought many innovations in soil measurement science, enabling measurements with higher levels of accuracy and in more efficient time. Technologies such as satellite mapping, geographical information systems (GIS), and geophysical sensors have made it possible to produce highly detailed topographic maps and land mappings, which are an important basis in planning and designing infrastructure projects [13]. The topographic measurement of an area of land is required to obtain data on the location, elevation, and shape of the land surface, which is the basis for building construction [14]. The management of geospatial data and information is undergoing continuous improvements, including through Presidential Decree No. 9 of 2016 on accelerating the implementation of the one map policy [15]. Currently, Farm Information Systems (SIPs) are growing rapidly at various levels of government in Australia, in response to the complex challenges of the future, such as integrating resource, environmental, and socio-economic data into pearly-based systems [16].

The objective of these measures is to gain a comprehensive understanding of the land to be built through measurement of the area of land, the creation of detailed topographic maps, and the analysis of the volume of land at various altitudes. Thus, the results obtained can be a strong foundation for planning and implementing construction projects efficiently, as well as determining the right zero point for a building.

The outcome of this process will include some important elements. First, there is an accurate measurement of the available land area, which gives a clear picture of the area that can be used for construction. Next, a land topographic map will provide details about the contours and shape of the land surface, allowing for a deep understanding of the natural characteristics of such land. An analysis of land volumes at various altitudes will help in planning the land changes needed, such as excavations or clusters, to prepare the development area. The results of this process will also provide clear guidance in determining the zero point of a building, which is an important foundation in the layout and construction of the building structure.
The contribution of these measures is crucial in planning and implementing development projects. With an in-depth understanding of land area, topography, and land volume, can optimize land use, identify potential challenges, and plan the necessary actions to prepare the development area. In addition, determining the correct zero point will also ensure that the building is built accurately and in accordance with the planning requirements. Thus, the

Journal of Civil Engineering and Vocational Education
EISSN: 2622-6774
Vol 11 No.3 September 2024
http://cived.ppj.unp.ac.id/index.php/CIVED

contribution of these measures not only ensures the success of the development project but also helps reduce risk and improve efficiency in resource use.

MATERIAL AND METHOD

Utilizing land measurement science, the Kediri area's development land is mapped for use as a reference in the building placement plan in the Pojok area, Mojoroto District, Kediri City [17]. The field of land measurement science collects field data by observing the state of the construction site's land surface and producing an image of the land. Theodolites, measuring signs, tripots, compasses, roll meters, water passes, and umbrellas are some of the tools used in this process. Determining the polygon frame, making measurements with theodolite equipment, and reviewing computations are the first steps in surveying land [18]. The stages intended in this investigation, together with a flowchart in the form of a:

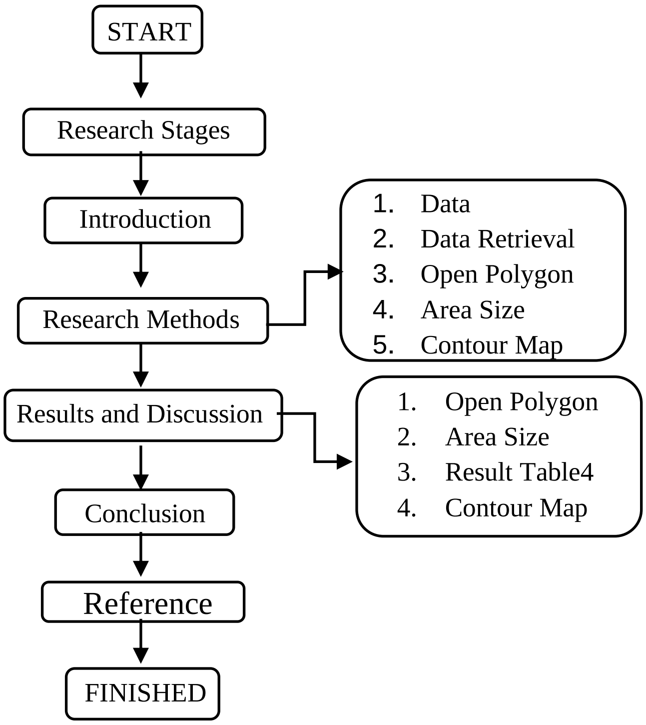

Figure 1. Research Flow Chart

Data Analysis

Geographic Information Systems (GIS) require the acquisition and utilization of data through a number of standardized steps. The first step in identifying objects or geographical elements is to make sure that each one is uniquely identified by a set of coordinates. Secondary data is gathered, encompassing attribute data like object descriptions and attributes as well as graphical data like digital maps and satellite photos. In order to guarantee that the location and descriptive (attribute) data are accurately connected in the GIS software, this data employs a particular coordinate system [19].

Additionally, field observations were used to get primary data directly from the research location. Photographs were taken to record object conditions, and GPS tracking was used to obtain coordinates. After that, the primary data was checked and added to the GIS. Following the integration of secondary and primary data, analysis was carried out using GIS software's mapping, visualization, and interpretation capabilities. The analysis's findings are shown in reports, graphs, or maps that are simple to read and utilize in making decisions [4].

Data Retrieval

Formulating the problem is a crucial first step in measuring the acreage on a property. This procedure entails determining and articulating the primary issues that need to be resolved during the land survey. The steps listed below can be used to formulate the issue succinctly and clearly:

a. Formulating the Problem

The first step in conducting research to identify the issues raised by the study that has to be done is called problem formulation. It will be utilized as a research reference based on the produced problem formulation in order to ascertain the topic of discussion. There are several questions in this statement of the topic that will be addressed after the research is finished. Every point made in the study, regardless of methodology or theory, is related to how the problem was formulated [20].

b. Establishing the Borders Between Land Sections

After identifying the location and limits of each parcel of land, boundary signs were installed at each corner in accordance with the needs of the land parcel in question in order to gather the necessary physical data [21].

c. Information Gathering

Direct field measurements, or primary data collection—where topographic measurements will be collected at the research location—and secondary data collection—which will bolster the study's findings—are the methods used to collect data. These topographic measurements will yield the following outcomes: a. Coordinate data (XYZ) b. Contour drawings c. Drawings of cross sections [20].

Using tools like theodolites, flat properties, measuring signs, meters, and other equipment, field observations are conducted to gather data through terrestrial measurements. Observed objects comprise both naturally occurring things and objects created by human involvement [22].

d. Data Analysis

There are two categories of data analysis techniques: qualitative analysis and quantitative analysis. The type of data is the only distinction between the two approaches. Quantitative data can be evaluated both quantitatively and qualitatively, but qualitative data cannot be counted and is analyzed using qualitative analysis. Qualitative data are unprocessed observations from the real world. Direct quotes, case studies, and thorough descriptions are examples of qualitative data. The objective component of quantifying social phenomena is emphasized more in quantitative research. Each social phenomenon is characterized using several problem components, variables, and indicators in order to perform measurements [23].

e. Final Presentation

A more comprehensive and current registration map that may serve as a reference for land sector planning and policy-making can be created if all land survey data has been mapped onto the map. A map showing the information about each land parcel is the outcome of the team's data processing and land survey procedures [24].

Open Polygon

Calculation with Polygon Method, calculating resources using the polygon method, which is a traditional method that uses the value of the data point as the center of the data to represent the region of influence. In the polygon method, an area in the center of the polygon is sometimes

CIVED Journal of Civil Engineering and Vocational Education

EISSN: 2622-6774
Vol 11 No.3 September 2024
http://cived.ppj.unp.ac.id/index.php/CIVED

referred to as the area of influence, which is formed by half the distance between two points and drawing a line to construct a boundary for each point. A polygon has a constant grade and thickness, which corresponds to the grade and thickness of the points inside its region of influence. To calculate resources using the polygon approach, first determine the borders for each point region and then calculate the area[25].
In general, open polygon measurements are the same as closed polygons, measuring angles and distances, and if necessary, azimuths, with the exception of properly bound open polygons, where the azimuth / angle of the direction can be computed from two sites with given coordinates. Angles can be measured in duplicate series. The angle at each point on the polygon is then calculated and averaged. Similarly, the distance is measured back and forth, with the results averaged. This average data will be utilized for calculations. Size data analysis should begin the instant measurements are taken. **f** = [final α - starting α + (n. 1800)] - (14) The corner coverage error is rectified by averaging the measured corners: k = f (15) n. If f is not divisible, the remainder of the division is further corrected for angles with short legs or polygon side lengths. The open polygon tolerance limit is the greatest distance between a polygon angle and the angle created by two adjacent polygon sides, which is often expressed as a percentage of the polygon length ranging from 0.1% to 0.5% [26].

Area Size

Measurement procedures are designed to meet the needs of the measurer. Polygon measuring is one of the methods used in area measurement science. Polygons, as the name implies, are made up of a number of straight lines that connect locations on Earth's surface. This measurement method uses field measurements to determine length and direction. These measurements will provide data on angle magnitudes and side lengths. The polygon measurement method works using coordinate points. The polygon measurement method is intended to calculate the coordinates of the measured angle. The polygon measuring method can also be used to calculate the horizontal position of many points [27].
The polygon technique makes use of various variables that influence the computation, including the area of the polygon block to be calculated, the thickness of the sediment, and the quality of the sediment. This research was carried out to determine the size of the field behind Kadiri University. The polygon approach involves creating a polygonal region of influence at each sample point, measuring it, and computing the average value of the content [28].
The formulas for finding the area of a polygon are as follows: Calculations include optical distance, horizontal angle correction, azimuth angle, distance correction, polygon point coordinates, polygon image plotting, and polygon area calculation. The polygon computation employs the angle cover error terms and the distance cover error terms, as illustrated in the formulae below:

$$\boldsymbol{F}sudut = 10\sqrt{\pi} \ldots\ldots\ldots..$$

$$\boldsymbol{F}jarak = \frac{1}{4000}\sum D\chi \ldots.$$

Where *n*: the number of measurement points, *f*angle: angle cover error (second), ΣDx: the amount of optical distance (meter), *f*distancing: distance closure error (meter) [29].

Contour Map

Contour map is a map that depicts some of the natural shapes of the earth's surface using the contour lines. This contour can give relief information, both relatively and absolutely. This relative relief is shown by depicting the contours closely for the tracked area, whereas for the area of the track it can be shown by describing the linearist sharply [30]. To create a contour map, you can use some popular software in the field of mapping and spatial data analysis. Some

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EISSN: 2622-6774
Vol 11 No.3 September 2024
http://cived.ppj.unp.ac.id/index.php/CIVED

such software are ArcGIS, QGIS, Surfer, and Global Mapper. Contour mapping involves a series of steps ranging from data collection and processing, gridding, contour making, to verification and presentation. Choosing the right griddings method is crucial to producing accurate contour maps [30][31].

RESULTS AND DISCUSSION

From the results and description of field data can be dealt with in the following table:

Table 1. Coordinate Analysis Data

Point		Wire Reading			Coordinate		
Tool Height	Target	Up	Middle	Down			
mm		mm	mm	mm	X	Y	Z
					202305010852.000	202305010702.000	100
P1	P2	972	741	510			
1460	T1	520	420	320	202305010832.796	202305010707.585	101.040
	T2	178	169	159	202305010853.784	202305010701.346	101.292
	T3	2600	2390	2180	202305010891.590	202305010687.978	99.070
	T4	1320	1302	1283	202305010852.955	202305010698.425	100.159
	T5	9120	8730	8340	202305010871.626	202305010626.509	92.730
	T6	1120	1020	920	202305010840.519	202305010685.683	101.835
	T7	1604	1482	1360	202305010834.954	202305010684.596	101.358
	T8	880	713	545	202305010849.863	202305010668.569	100.922
	T9	1004	827	650	202305010855.037	202305010666.739	101.408
	T10	1155	940	725	202305010860.717	202305010659.893	100.753
P2	P1	3060	2830	2600	202305010852.000	202305010702.000	
	T1	1565	1483	1400	202305010864.217	202305010690.913	101.635
1410	T2	1470	1396	1322	202305010859.552	202305010689.274	101.692
	T3	1440	1345	1250	202305010859.024	202305010684.349	101.817
	T4	1350	1216	1082	202305010854.273	202305010675.301	102.082
	T5	1230	1040	850	202305010850.351	202305010664.042	102.453
	T6	1140	935	730	202305010846.823	202305010661.334	102.611
	T7	950	715	480	202305010838.877	202305010656.877	102.935
	T8	592	346	100	202305010829.273	202305010658.372	103.343
	T9	530	315	100	202305010823.886	202305010669.473	103.265
	T10	1042	871	700	202305010828.247	202305010677.401	102.556
	P3	1030	686	342	202305010852.000	202305010702.000	101.420
P3	P2	2330	1990	1650	202305010852.000	202305010702.000	100.768
	T1	1583	1538	1492	202305010860.263	202305010698.189	100.895
1450	T2	1630	1563	1495	202305010863.330	202305010694.660	98.408
	T3	1410	1351	1292	202305010858.437	202305010692.110	99.125
	T4	1390	1335	1280	202305010855.552	202305010691.589	91.539
	T5	1348	1289	1230	202305010853.217	202305010690.263	100.320
	T6	1320	1276	1232	202305010851.771	202305010693.203	99.436
	T7	1201	1551	1900	202305010899.541	202305010753.243	99.076
	T8	1070	1000	930	202305010839.252	202305010696.214	100.272

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	T9	1055	978	900	202305010836.754	202305010699.208	100.029
	T10	885	785	685	202305010832.166	202305010699.431	0.000

Open Polygon

After a soil mapping, the results can be displayed in a form of visualization that includes the form of an open polygon as well as a result narration in detail of the number of points associated. This visualization will clearly show the shape and contour of the soil, while the result narrative provides a deeper understanding of the data collected.

Open Polygon Shape Visualization:

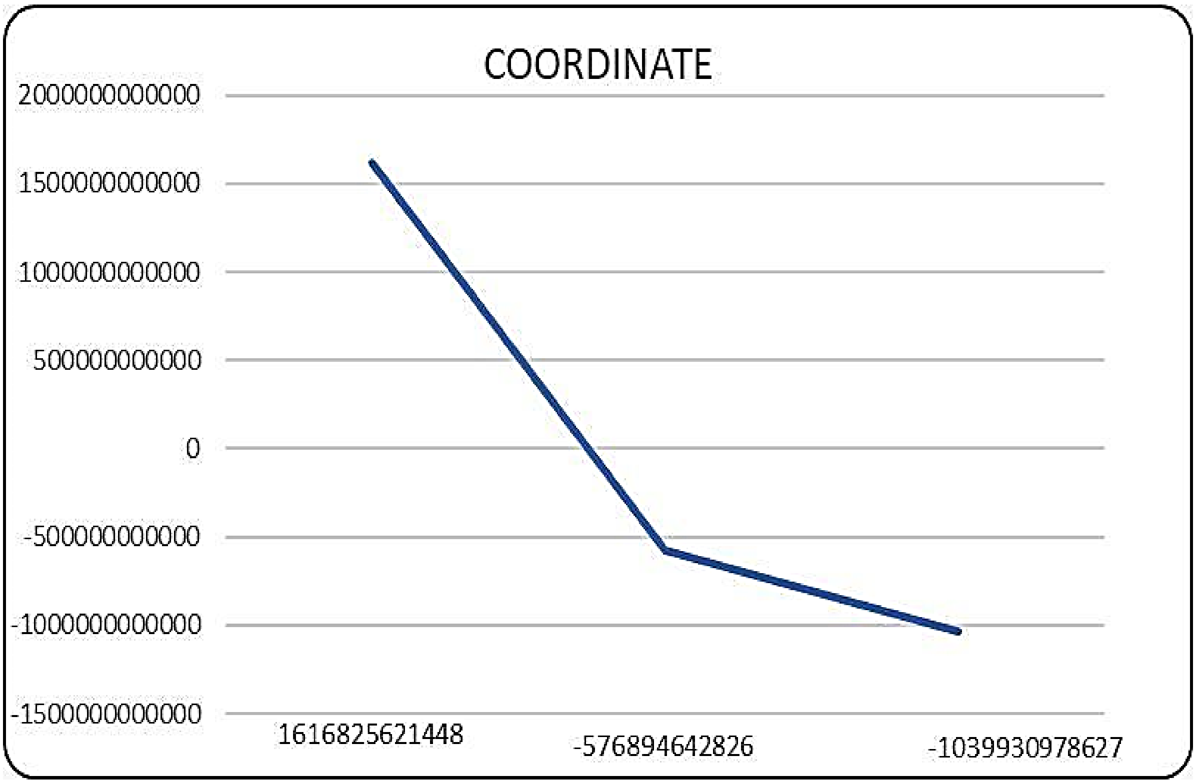

Figure 2. Open Polygon Curve

The mapping results recorded 3 major points using an open polygon method that was successfully identified. A total of 26 ground contours and 4 road contours were recorded. In order to ensure the accuracy and precision of the results, corrections are required on the calculations of open polygons during the mapping process. This correction involves adjusting the data to take into account field variability and inaccuracies of measuring instruments, so that the resulting data can be reliable for further analysis and correct decision-making. This process also helps in identifying potential errors that may affect the final outcome and ensuring that each point drawn corresponds to the actual field conditions. With this visualization and narration, land mapping results can be presented comprehensively, producing accurate and clear data, thus providing a better understanding of the conditions of the land painted and the accuracy of the data obtained.

Total Area

Based on the data from the calculations, the result is as follows:

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EISSN: 2622-6774
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Table 2. Coordinate Data and Polygon Area

Titik	Coordinate		Area Calculation	
	X	Y		
P1	202305010852	202305010702	0	
P2	202305010858	202305010696	1616825621448	
P3	202305010868	202305010687	-576894642826	
P4	202305010852	202305010702	-1039930978627	
P2	202305010858	202305010696		
Area			-5.00	m^2
			-0.0005	Ha

Source: Data Processed, 2024

From the calculation Table 2 shows the results of the large calculation of the measurement area of -5.00 m2 or -0.0005 Ha. Using the method of the coordinate point X, and Y of the outer measuring point of the open polygon.

Contour Map

From the observations carried out, a contour map can be created in the form of 2D and 3D as follows:

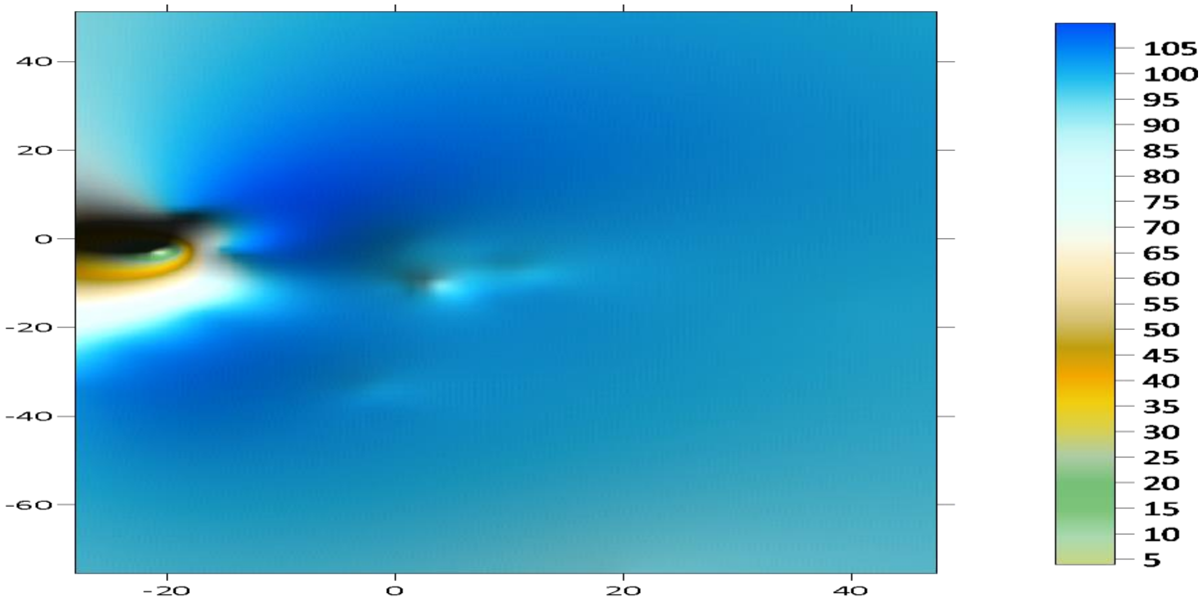

Figure 3. 2D and 3D Contour Map

The land mapped has a maximum height of 90,0945 masl and a minimum of 88,76 masl with an average height for 90,05059 masl. The altitude of the flat road is 88.86175 masl.

CONCLUSION

Calculation with the Polygon Method, the resource calculation using the polygon method where this method is a conventional method using data point values as data centers to represent the area of influence. In the polygon method, an area in the center of a polygon is often called an influence area by dividing two between the distance of one point to another and pulling a line to form a boundary of the area of influence for each point. As a polygon has a constant rate and thickness with the rate as well as the density of the point that is within the area of influence (polygon). Since an open polygon can only form an area that can be measured, an open Polygon is only a path that does not form a complete boundary, so the measurable area of an open polygon is zero. From the observations carried out, it is possible to make a contour map in the form of 2D and 3D with the result of the land mapped has a maximum height of 90,0945 masl and a minimum of 88,76 masl with an average average ground height 90,05059 masl while the average road height is at 88,86175 masl. related to the research findings

REFERENCE

[1] G. S. Airlangga, Analisis tingkat kebisingan di sekitar kawasan bandara sultan thaha jambi akibat aktivitas lalu lintas pesawat berbasis sistem informasi geografis. 2023.

[2] M. S. Dr. Arief Darmawan, S. Hut. and S. H. Cecilinia Tika Laura, “Buku Panduan Praktikum Pemetaan Hutan dan SIG 2020,” Pandu. Prakt. Pemetaan Hutan dan SIG, vol. 11, no. 1, pp. 22–31, 2020.

[3] Arief Rahman, Renny Puspita Sari, and]Dian Prawira, “Sistem Informasi Geografis Pemetaan Lahan Pertanian Dan Komoditi Hasil Panen Berbasis Website,” J. Komput. dan Apl., vol. 11, no. Volume 11, No. 01 (2023), hal 83–91, pp. 83–91, 2023.

[4] A. Basit Amir, R. Musa, and H. Ashad, “Sistem Informasi Geografis (SIG) pada Jaringan Drainase Kota Watampone,” J. Konstr., vol. 1, no. 7, pp. 40–48, 2022.

[5] Q. R. Aliyah and B. Cahyadi, “Pemetaan Tingkat Kebisingan Pada Bengkel Pipa Dan Mess Karyawan I Dengan Metode Peta Kontur,” J. Sipil Statik, vol. 8, no. 2, pp. 249–256, 2020, [Online]. Available: https://jurnal.umj.ac.id/index.php/semnastek/article/view/14691

[6] T. Chen, X. Zheng, R. Niu, and A. Plaza, “Open-Pit Mine Area Mapping With Gaofen-2 Satellite Images Using U-Net+,” IEEE J. Sel. Top. Appl. Earth Obs. Remote Sens., vol. 15, pp. 3589–3599, 2022, doi: 10.1109/JSTARS.2022.3171290.

[7] F. Fahriani and Y. Apriyanti, “Pemetaan Kondisi Tanah di Pesisir Pantai Kabupaten Bangka,” J. Ilm. Rekayasa Sipil, vol. 19, no. 1, pp. 46–52, 2022, doi: 10.30630/jirs.v19i1.729.

[8] A. Tanto, “Analisis Tumpang Tindih Penguasaan Bidang Tanah Berdasarkan Surat Pernyataan Penguasaan Fisik Bidang Tanah (SPPFBT) Dengan Sertifikat Hak Pengelolaan …,” Indones. Notary, vol. 3, 2022, [Online]. Available: https://scholarhub.ui.ac.id/notary/vol3/iss4/5/%0Ahttps://scholarhub.ui.ac.id/cgi/view content.cgi?article=1139&context=notary

[9] R. Yunita et al., “Pengukuran Perencanaan Drainase pada Pembangunan Stadion di Tanjung Haro Sikabu-Kabu,” J. Pustaka Paket Pus. Akses Kaji Pengabdi. Komput. dan Tek., vol. 2, no. 1, pp. 10–15, 2023.

[10] H. Li, J. Q. A, and J. T. A, “Pengelolaan Air Pertanian pengurangan polusi dan

peningkatan kualitas tanah di lahan pertanian miring dari Tiga," vol. 297, no. April, 2024.

[11] G. Yasada, "Penentuan Kontur Tanah dengan Menggunakan Teknologi Global Positioning System dan Citra Satelit Aster di Desa Manggis, Karangasem, Bali," Matrix J. Manaj. Teknol. dan Inform., vol. 10, no. 2, pp. 58–64, 2020, doi: 10.31940/matrix.v10i2.1890.

[12] D. Kautsar et al., "Jurnal Hukum Non Diskriminatif Dinamika Sengketa Tanah di Dago Elos Bandung Jurnal Hukum Non Diskriminatif," vol. 2, no. 2, pp. 115–122, 2024, doi: 10.56854/jhdn.v2i2.310.

[13] R. Kurniawan, "Aplikasi Teknologi Terkini dalam Ilmu Ukur Tanah: Pengukuran yang Akurat dan Efisien," Ilmuteknik.Org, vol. 3, no. 3, 2024, [Online]. Available: http://ilmuteknik.org/index.php/ilmuteknik/article/view/197

[14] S. Buana, N. Nurhakim, and R. N. Hakim, "Perhitungan Sumberdaya Batubara Menggunakan Metode Polygon Dan Metode Isoline Pada Wilayah Iup Pt Usaha Baratama Jesindo," J. Himasapta, vol. 5, no. 1, pp. 5–8, 2020, doi: 10.20527/jhs.v5i1.2045.

[15] I. G. K. Artika and W. Utami, "Percepatan Pembenahan Data Bidang Tanah Kluster 4 melalui Survei Data Pertanahan," BHUMI J. Agrar. dan Pertanah., vol. 6, no. 1, pp. 66–79, 2020, doi: 10.31292/jb.v6i1.425.

[16] A. S. Millah, Apriyani, D. Arobiah, E. S. Febriani, and E. Ramdhani, "Analisis Data dalam Penelitian Tindakan Kelas," J. Kreat. Mhs., vol. 1, no. 2, pp. 140–153, 2023.

[17] M. Arif, R. Hartono, and D. Arinta, "Pengembanan Laboratorium Geografi Berbasis Mobile Virtual Pada Materi Pembelajaran Praktikum Ilmu Ukur Tanah," J. Dimens. Pendidik. dan Pembelajaran, vol. 11, no. 2, pp. 181–191, 2023, doi: 10.24269/dpp.v11i2.7006.

[18] F. A. Eviana, "Pemetaan Kondisi Jalan Strategis Kabupaten Di Kabupaten Tulang Bawang Barat," 2023, [Online]. Available: http://digilib.unila.ac.id/id/eprint/70851

[19] A. Hajar, I. Nabawi, L. Kartikawati, F. R. Yudana, S. Budi, and N. Prasetiyantara, "Pengolahan Data Spasial-Geolocation Untuk Menghitung Jarak 2 Titik," Creat. Inf. Technol. J., vol. 8, no. 1, p. 32, 2021, doi: 10.24076/citec.2021v8i1.265.

[20] D. N. Purwati, "Pengukuran Topografi Untuk Menghitung Volume Cut and Fill Pada Perencanaan Pembangunan Perumahan Di Km. 10 Kota Balikpapan," J. Tugas Akhir Tek. Sipil, vol. 4, no. 1, pp. 12–23, 2020.

[21] M. R. M. Fauzan, J. Jupri, and R. Ridwana, "Pengukuran Topografi Untuk Pembangunan Penampungan Air Bersih (Studi Kasus: Daerah Rajamandala, Kabupaten Bandung Barat)," JPIG (Jurnal Pendidik. dan Ilmu Geogr., vol. 6, no. 1, pp. 35–48, 2021, doi: 10.21067/jpig.v6i1.5141.