Figure 24 May Vour World, Our World: Resilient Environment of All

Analyzing a Section of Ahmadu Bello University's Electrical Grid Using Geometric Network Analysis and Trace Function

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PRESENTATION OUTLINE

INTRODUCTION

MATERIALS AND METHODS

RESULTS AND ANALYSES

CONCLUSION







INTRODUCTION

Electricity is the flow of electrons between two points with a potential difference, resulting in an electric current.

The electrical grid: generating plants, transmission lines, substations, transformers, distribution lines, etc

GIS can be used to manage, model and analyse electricity grids, and for the design and analysis of various networks: electricity, gas, or water







INTRODUCTION cont.

GIS can also help identify affected areas in case of power outages within the minimum time possible.

There are existing works related to this study:

✤Mapping and modelling an electrical power network on the web (Rajab, 2016);

Modelling of electricity distribution networks using satellite imageries and spatial data (Damilola, 2013)

implementation of utility management systems (Sree and Phani, 2016)





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INTRODUCTION cont.

In the study area, the grid does get sabotaged by factors like wind, rain, etc.,

The unnecessary delays in responding to such faults caused by these factors is present also.

In this study, we analysed a section of Ahmadu Bello University's Electrical Grid by running a geometric network





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INTRODUCTION cont.

The study area covered about 9.50 km in perimeter; it spans 11° 8'59.47"N, 7°39'55.50"E; 11° 8'14.32"N, 7°38'50.25"E and 11°10'2.35"N, 7°37'58.39"E.

it was divided into two parts, the staff quarters and the main campus.









FIG FIG Working Week 2024 19-24 May Vour World, Our World: Resilient Environment Accra, Ghana







FIG Norking Week 2024 19-24 May Nour World, Our World: Resilient Environment Accra, Ghana

MATERIALS AND METHODS

• Data acquisition

Table 1: Datasets

S/n	Data type	Data name	Data date	Source	Purpose	Description
i.	Secondary	Area Extent	2019	Google Earth	Determining the nature and extent of the study area.	Satellite imagery and perimeter coordinates
ii.	Primary	Spatial Data (E, N)	2019	Garmin ETrex20 GPS	To create a geodatabase of the features in the network	Coordinates of the features in the network.





FIG FIG Working Week 2024 19-24 May Vour World, Our World: Resilient Environment Accra, Ghana

MATERIALS AND METHODS

Data Processing

Categorisation and Cataloguing

Processing in ArcMap

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2	3527	96	123214	44						
3	35276	8.8	123210	64						1
4	35277	7.7	123219	96			1			
5	352980	0.7	12321	71						
6	353040	0.6	123213	32						
7	35310	1.6	123209	96						
8	353093	3.7	123204	43						
9	3530	88	123199	93						
10	35308	3.4	123193	38						
11	35307	7.7	123189	94						
12	35307	5.3	123184	47						
13	35313	3.2	12318	37						
14	353199	9.6	123179	91				_		
15	35322	5.5	12317	20						
16	35323	8.4	12316	82						
17	35325	8.9	123163	26						
18	35327	7.3	12315	84						



The catalogued data (in Excel)

Creating a Geodatabase in ArcCatalogue





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MATERIALS AND METHODS

The Geometric Network

Datasets;

Designing a Geodatabase Topology;

The Network



Creating geometric network





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Trimble.

MATERIALS AND METHODS

The Geometric Network

The thresholds set for the geometric network wizard:

- *i.* RMUs were set "sources";
- ii. Transformers were set as "sinks"
- iii. Edges were set as complex edges.



PLATINUM SPONSOR



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RESULTS AND ANALYSES

The geodatabase of the spatial attribute of the features/facilities

VIII)	les_Two					
	OBJECTID *	Shape *	Field1	Field2	Field3	Enabled
57 H L	1	Pont	352842.9	1232132.21	<7820>	True
	2	Point	352795.98	1232143.59	<nub< td=""><td>True</td></nub<>	True
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	4	Point	352777,65	1232195.55	<100Þ	True
26.5	5	Point	352960.69	1232171.4	<nut></nut>	True
	6	Point	353040.59	1232132.41	<nut></nut>	True
	7	Point	353101.59	1232095.64	<nub< td=""><td>True</td></nub<>	True
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	12	Point	353075.34	1231846.9	<tube< td=""><td>Tive</td></tube<>	Tive
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	15	Point	353225.49	1231720.13	<nul></nul>	True
	16	Point	353238.42	1231682.47	<nub< td=""><td>True</td></nub<>	True
	17	Point	353258.92	1231625.97	<nut></nut>	True
	18	Point	353277.3	1231583.86	<null></null>	True
	19	Point	353298.91	1231532.88	<nul></nul>	True
	20	Point	353322.71	1231483.01	<hub< td=""><td>True</td></hub<>	True
	21	Point	353368.38	1231437.45	Needs adjustment	True
	22	Point	353399.72	1231363.21	<nub< td=""><td>True</td></nub<>	True
	23	Point	353397.25	1231301.28	<null></null>	True
te 2	24	Point	353413.42	1231253.65	shub	True
	25	Point	353448.00	1231101.58	«Null»	True
	26	Point	353273.66	1232015.45	Central Store 1st	Faite
-	27	Point	355160 10	1232657.77	eth its	True

Geodatabase in ArcMap.

Table 2: Features involved in the network

S/n	Feature	Quantity	%
i.	Poles	201	88.16
ii.	Ring Main Units (RMU)	9	3.49
iii	Transformers	18	6.98



Transformers and RMUs Features (%)





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RESULTS AND ANALYSES

The geodatabase of the spatial attribute of the features/facilities

Table 3: RMUs in the network and transformers they feed.

S/n	Central store	Dam	Post Office	Energy Researc h	ABU Press	Sassakwa
i.	Area A Part 1	DAM	Micro Finance	Energy Research	Water Resources	Anatomy
ii.	Area A Part 2		Senate building		Sassakwa	Vet. Medicine
iii.	Energy Research		Demonstration		ABU Press	ABU Site II
iv.	Silver Jubilee Quarters		Centre of excellence			
V.	Area H		PG School			







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RESULTS AND ANALYSES

✓ Flow Analysis

- The map shows where each RMU (Source) is sending its supply to
- And where each transformer (Sink) is getting its supply from.
- The flow can be either determinant.

indeterminate, or uninitialized.



Flow of power





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RESULTS AND ANALYSES

The Trace analysis

- The flow analysis will let you trace each sink to its source and vice versa following the direction of the arrow alone, but it doesn't allow for isolated traces.
- the tracing flag (the green square) was set at a house in Silver Jubilee quarters and traced down to its source RMU



Tracing a house in Silver to its RMU





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RESULTS AND ANALYSES

The Trace analysis

the flag was set in Area H transformer and Silver Jubilee Transformer and traced down to their source RMU



Trace from Area H transformer to its RMU

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RESULTS AND ANALYSES

The Trace analysis

Here 2 RMUs are involved which output 7 output to 7 transformers altogether.

Geometric Networks do not allow for multi-directional flow thus, wherever there is one it will be set as an indeterminate flow.

An indeterminate flow

A trace error from a multi-directional flow

FIG FIG Working Week 2024 19-24 May Vour World, Our World: Resilient Environment Accra, Ghana

RESULTS AND ANALYSES

The Trace analysis

This error encountered is because an RMU

feeds another RMU.

The problem here is that an RMU is a source in the network and a Geometric network does not allow for flow from one source to another source.

A clash between two RMU's (sources).

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CONCLUSION

The importance of the use of GIS in the utility industry are shown in this paper.

The geometric network analyses in this study is helpful but not 100% efficient enough.

Analyses show that there are RMUs that can still take more transformers.

Network analysis should be considered because determining the shortest routes possible to a particular place is vital for utility companies.

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Thank you for listening

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