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Mapping of Underground Electricity Network using GIS Software for Aurangabad City

Sachin Bajaj, Amol Adhave

M.Tech Student, Department of CS & IT, Dr.Babasaheb Ambedkar Marathwada University, Aurangabad, Maharashtra,

India

ABSTRACT: Making or modifying cities to Smart city is a current development issue going all over the world. India as also announced a project for making 100 Smart cities. For a smart city it's a basic requirement to manage the city's Infrastructure. For better management and proper utilization of land, developers have started using underground space replacing unwanted overhead space. That includes underground supply of water mains, drainage system, electricity supply, communication lines, gas lines, also for transportation (by metros) etc. To manage all this underground network its mandatory to use their flow maps on the systems so that actual faults can be easily located and proper actions can be applied on it. Mapping will help to quickly locate the faults, to detect the free space for new connections or to remove the unwanted connection. The overall infrastructure can be well managed and maintain using actual mapping of the underground infrastructure. In this paper we will focus on electricity Distribution Network. For managing an underground infrastructure will play a vital role in future development. So we have mapped a part of Aurangabad city for electricity network using QGIS. The management of this mapped data can be maintained by proper updating of the database related to the mapping.

KEYWORDS: GIS, GPS, Electricity Network, Mapping.

I. INTRODUCTION

Development of Smart City is a current issue all over the world. Smart cities basic aspects are to provide smart electricity, smart transportation, smart water supply management, smart security, etc. As in most of the urban areas, the empty land spaces are rarely available so the development team are planning and had stated implementing their projects to utilize underground land surface. The underground land surface can be used for transportation of water supply, electricity supply, gas supply, communication channels, etc. Management and maintenances of this underground system is difficult than overhead system. So it's important to check that the systems are properly designed before implementation. As all the underground network can be visualized more easily on a system using some maps and models of the system that helps for maintenance of this infrastructures.

In India, most of the electrical cables are strung overhead and due to natural phenomena such as heavy Rains, earthquakes, Storms, accidents, bad vegetation may cause inconsistency in electricity network. Due to such accidents if the wires breakdown, it may cause power loss, short circuits, etc. These all effects can be avoided by using underground supply of electricity. In addition undergrounding protects electrical equipment from vegetation and bad weather. It also helps to create more open space in neighbourhoods. Undergrounding any supply network is comparatively more expensive than building overhead networks [1].

Mapping of underground electricity network infrastructure will help to quickly locate the faults, to detect the free space for new connections or to remove the unwanted connection. The overall infrastructure can be well managed and maintain using actual mapping of the underground Network. Looking towards the current situation the management teams maintain this data on papers, spreadsheets tabular format, maps, etc. however this type of data is insufficient to locate the exact positions. Also it is difficult to maintain and update the data. This all drawbacks can be avoided if the data is been live time updated i.e. can be maintain online and time to time. This database will help in making the decisions on the network.



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II. RELATED WORK

Sometimes Electricity is a very useful and demanding utility in today's life. Management of these utility is a key factor for the development team. The arising technology of Geographic Information System (GIS) has become a very imported tool for automated mapping of the electricity network. GIS is a technology that provides us to design, analyze, store, and manage spatial data. GIS Help in electrical utilities for maintenance planning, visualize modeling, information collection etc. checking to the current situation of managed database, there is a huge demand for acquiring these technologies. Global Positioning System (GPS) technology helps to detect the exact location of the components such as poles, transformers, substations, buildings, wire-lines, etc. So it is important while mapping the network structure. GIS Provides an adequate platform for network representation and maintenance and also database can be managed and updated periodically [2].

The electrical distribution network will be overlaid on a base map in different layer based on components such as transformer layer, substation layer, main-supply layer, poles layer etc. The layers are mapped on the basis of the components location captured using GPS Technology in a database development. The layers can be generated in different GIS software that can be later merged together to make the mapping model. The layers can be designed using point layer, line layer or polygon layer as per requirement. Alone with the layer the specific information can be added to the layer that specifies the detail about the components i.e. type of component, ID, Location, technical details etc. Using this information a complete attribute database can be fetched for backup database. The layer output will be shape file that can be distributed among the departments as a file data [3].

Database plays an important role in management and decision making. The network analysis will become much simpler by using Database management system. GIS Database consists of both spatial data and non-spatial data. Spatial data gives the information about the location of the components and non-spatial data gives the information about the attributes of the components. This database once completely created and well maintained they can be used for modeling of power distribution network. Using this data, analysis can be done for predicting faults and hazards in the network with a short interval of time. GIS provides secure maintenance and easy data updating facility.

Hasan and aktar have discussed the importance of GIS in management of power distribution network. Current management lack for timely updated data, finding previous record is a time consuming job, and also due to hard copy maps and paper work database it's difficult to store properly and secure, so using GIS mapping model for electricity network will help to maintain records updated, easy retrieval of previous or current data, avoid site survey for new connection or for modifying the connections, etc. The model gives the power distribution network in front of eyes [4]. Parkpoom presented a conceptual model designed on Power network based on GIS Technology. In this model they have calculated a location using GIS and GPS technologies to locate the components on the map. Further each component was located on the base map using GIS and separate layers were created for each component. Finally each component must be overlaid on a base map to generate a mapping model for the power network. Benefits of this model are easy database management, reduction in technical loses, easy decision making [5]. A similar implementation was done in Bhopal city in India, in this project they have specified that the data was collected by using GPS tools and Google Earth images. GPS was used to locate the components and satellite images for base map of the location. Both the data was integrated on a single map and the final model was generated [6]. similarly, another implementation was done in CHENNAI City in India, vijayee described in her article that implementation was done on the basis of coordinate of the electrical network entities and a base-map. In this work different layers were generated for different components and were imposed on a map for that location. Attributes information was added to create a corresponding database. The distribution network was to be hosted on website, and updated periodically to maintain it properly [7].

III. EXPERIMENT AND RESULTS

Figures Implementation Of this project includes:

- Survey
- Data Collection



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- Database Development
- Creation of Map
- Publishing Map
- **1. Survey:** Survey of current situation of power distribution network, its maintenance, studying database records and its management.
- 2. Data Collection: Data collection is done by visiting the location of the electrical components and capturing their co-ordinates. For main supply lines (wiring) the starting and ending co-ordinates were noted and mapped on that basis. This process was done for entire mapping components. The coordinates were captured using GPS technology in Smartphones. Along with the coordinates also attributes of the components were noted to create the database.
- **3. Database Development:** The captured data was arranged in the required format in an excel sheet and a .csv (comma separated value) file was developed. In the database along the coordinated attribute information was also added. Figure 1 and Figure 2 shows the database table for cables and Transformers respectively.

1	А	В	С	D	E	F	G
1	ID	WKT	type	daimeter	capacity	depth under	
2	1	LINESTRING (75.308897 19.907369,75.309125 19.906745)	XLPE	40	440	0.7	
3	2	LINESTRING (75.308983 19.905412,75.310205 19.905263)	XLPE	40	440	0.7	
4	3	LINESTRING (75.310030 19.9045146,75.310357 19.904705)	XLPE	40	440	0.7	
5	4	LINESTRING (75.309391 19.903717,75.309152 19.903599)	XLPE	40	440	0.7	
6	5	LINESTRING (75.309799 19.903250, 75.309584 19.903071)	XLPE	40	440	0.7	
7	6	LINESTRING (75.308597 19.901558,75.311179 19.901408)	XLPE	40	440	0.8	
8	7	LINESTRING (75.312260 19.904303,75.311990 19.901044)	XLPE	40	440	0.8	
9	8	LINESTRING (75.311575 19.905040,75.311482 19.904361)	XLPE	40	440	0.8	
10	9	LINESTRING (75.311162 19.907662, 75.312195 19.907371)	XLPE	40	440	0.8	
11	10	LINESTRING (75.313618 19.906420,75.313439 19.904966)	XLPE	40	440	0.6	
12	11	LINESTRING (75.314519 19.904918,75.314476 19.903576)	XLPE	40	440	0.6	
13	12	LINESTRING (75.314528 19.906890,75.314670 19.906905)	XLPE	40	440	0.6	
14	13	LINESTRING (75.314574 19.907227,75.315163 19.907187)	XLPE	45	580	0.6	
15	14	LINESTRING (75.313130 19.908852,75.313919 19.908640)	XLPE	45	580	0.6	
16	15	LINESTRING (75.312331 19.908970, 75.312363 19.908675)	XLPE	45	580	0.6	
17	16	LINESTRING (75.313468 19.911424,75.313168 19.909870)	XLPE	45	580	0.7	
18	17	LINESTRING (75.310000 19.896055,75.309885 19.895101)	XLPE	45	580	0.7	
19	18	LINESTRING (75.310850119.895835,75.310786 19.895702)	XLPE	45	580	0.7	
20	19	LINESTRING (75.31129 19.896253,75.311558 19.896272)	XLPE	45	580	0.7	
21	20	LINESTRING (75.313382 19.896897,75.314262 19.896514)	XLPE	45	580	0.7	
22	21	LINESTRING (75.309128 19.906743,75.311107 19.906733)	XLPE	45	580	0.7	
23	22	LINESTRING (75.313114 19.908155,75.312840 19.905038)	XLPE	45	580	0.7	
24	23	LINESTRING (75.314604.19.907657.75.314353.19.904908)	XIPE	45	580	0.7	

Figure 1: database for cables

Figure 1 gives the detail about the line layer used in the mapping network for representing the cables. The data base created was a CSV file such that it contains a WKT file format. WKT file format is LINESTRING(point 1 coordinates, point 2 coordinates).



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24	А	В	C	D	E	F	G
1	x	Y	Name	KVA	date of manu	gaurantee	type
2	75.310786	19.895701	V.C.Lodge	100	Feb-14	5 Years	3 phase
3	75.313382	19.896897	Sports D.T.C.	300	Jun-13	5 Years	3 Phase
4	75.311558	19.896272	Ladies Hostel D.T.C.	100	Jan-13	5 Years	3 Phase
5	75.309885	19.895101	Auditorium D.T.C.	160	May-05	5 Years	3 Phase
6	75.312137	19.900672	Botany Garden D.T.C.	200	Jun-15	5 Years	3 Phase
7	75.312223	19.904645	History & Museum D.T.C.	200	Nov-14	5 Years	3 Phase
8	75.314671	19.906905	Exam D.T.C	100	Dec-13	5 Years	3 Phase
9	75.315163	19.907187	Estate D.T.C.	100	Feb-15	5 Years	3 Phase
10	75.309584	19.903071	CS&IT D.T.C.	200	Jan-14	5 Years	3 Phase
11	75.309154	19.903595	C.F.A.R.T. D.T.C.	100	Jan-14	5 Years	3 Phase
12	75.308983	19.905411	Soneri Mahal D.T.C.	100	Apr-14	5 Years	3 Phase
13	75.308897	19.907368	Behind Soneri Mahal D.T.C.	100	Jul-15	5 Years	3 Phase
14	75.313296	19.910778	Caves D.T.C.	100	Mar-14	5 Years	3 Phase
15	75.305293	19.899197	S.A.I. D.T.C.	100	Jan-15	5 Years	3 Phase

Figure 2: Database for transformers

Figure 2 gives the detail of the point layer used in mapping network for representing transformers and substations. In the figure 2 we have shown a database created as a CSV file that contains X and Y coordinated. Here X and Y represent longitude and latitude respectively for the points used in the map.

4. Creation of Map: The Created database where imported in a software QGIS. These databases were uploaded as a layer for the map. QGIS Provide a facility to select different base maps of our choice using open layer plugins. Also QGIS provides formatting the layer such as styling i.e. changing size of layer, changing colour, etc. also labeling, setting CRS for the layer etc. Figure 3 shows the created electrical network map for BAMU University Aurangabad. Figure 4 shows the attribute data for transformer layer in QGIS.



Figure 3: Electricity map for BAMU University

Figure 3 shows the complete mapping network designed after uploading the database files to the GIS Software named QGIS. Using a special plugins we have also added a base map to the network.



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Figure 4: Attribute Data

Figure 4 shows the attribute table associated with the layers uploaded in the software for mapping the network. This attributes tables contains the detail of each point or line or polygon used in the network.

5. Publishing Map: The Final Map can be published for sharing it to other users. QGIS provides this facility to publish the map on the browser. Figure 5 shows the published map.



Figure 5: Published Map

Figure 5 shows the details about a map and also shows the attributes associated with it. The designed mapped network can also be published on the websites as shown in figure.



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IV. CONCLUSION

We Electricity Network is an important utility. GIS plays a vital role in mapping such utilities and their components. GIS helps to manage this utilities, is a technology used for today's development. This technology will improve the maintenance and management techniques for the developers. Using this type of electrical mapping will help the management team to use updated data on system instead on paper maps. This map will also be useful for planning new connections, modifying existing connections, detecting faults, etc. It will help to avoid the damage made will new construction or finding existing components, etc. Once the complete city network is been mapped, it would be the basic need for future development. Using this map different portal may be created for smart management of the network.

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REFERENCES

- [1] S.Bajaj "A Review on: Underground Electricity and Communication Infrastructure" IJIRCCE Vol. 4, Issue 4, pg. no. 7686-7695 April 2016.
- [2] M.V.K.Rao, B.S. Varma and C. Radlhakrishna "Experiences on Implementation of GIS based tools for analysis, Planning and Design of Distribution System" IEEE july 2008.
- [3] N.Sekhar, K. S. Rajan, and A.Jain, "Application of Geographical Information System and Spatial Informatics to Electric Power Systems" NPSC, pg. no. 254-259, Dec 2008
- [4] H.T Hassan, M.Akhtar, "Mapping of Power Distribution Network using Geographical Information System (GIS)", IJETAE, Volume 2, Issue 6, page no. 343-347, June 2012.
- [5] N. Parkpoom, "GIS-based model for implementation on Power Transformer planning within Thailand Power Network", AORC-CIGRE Technical Meeting, pp-918-925, sept 2013
- [6] T.Thakur, "GIS Based Power Distribution System: A Case study for the Bhopal City", [Online] Available: http://www.indiacore.com/bulletin/papers-it08/Dr-Tripta-Thakur-MANIT-GIS-Based-Power-Distribution-System-A-Case-Study-for-the-Bhopal-City-Paper.pdf
- [7] Mrs.N.Vijayee, "MAPPING OF CHENNAI ELECTRICITY DISTRIBUTION NETWORK", 10th ESRI India User Conference 2009.