Use the application of geographic information systems in the distribution of the electrical network

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Abstract. The distribution of the electrical network on the spatial structure, especially within cities, and for the end-users to different spatial obstacles, through this research, the importance of using geographical information systems applications in the process of distributing and managing the electrical system can be identified. This study evaluates the spatial relationship between the electric distribution company and the nature of the link between them and among the end users in the study area (the city of Tal Afar), to find a way to optimize the distribution and management of how electricity is distributed. The study indicates that the study area contains only one transformer of 132KVA class distributed 16 lines of 11KV class and 5 lines of 33KV class, and a second transformer of 11KV class distributed 4 lines of 11KV class and one line of 33KV class to serve about 16,837 housing units, Which has an average consumption of 5.06KV, which indicates that the transformers are burdened with approximately 663KV, which confirms the importance of proper management according to modern technology through which to invest time and costs easily.

1. Introduction

The geographic information systems technology is considered one of the most important technologies that have multiple uses in the spatial dimension, which contributed mainly to the advancement of the reality of modern life through controlling energy to serve the economic, social and technical development of any country. Currently, electric energy is the cornerstone of economic development and is a stone the basis for any development project.

The process of control and proper management with an economic return on electrical energy needs an advanced system through which it is possible to identify the energy efficiency currently equipped, and the amount of deficit or bottlenecks that the network suffers from, so a complete and accurate inventory must be prepared of the nature of the spatial distribution of generation or processing stations and power transmission lines and transformers electrical using geographic information system.

1.1 Geographical Information Systems.
Technology is a software application, used to create and display information, process, organize and analyze the spatial reference database and produce outputs in the form of a table and map.
However, GIS consists of five components: software, data, procedures, devices, and people. The components work together to capture, store, retrieve, analyze, and view geographic references. It has an additional ability to analyze spatial data, by analyzing feature, location, or spatial modeling (Figure 1).

![Figure 1. Major tasks in GIS](image)

The high efficiency in the work of the electric power system cannot be achieved without there being a system that relies on keeping records properly and monitoring the distribution network system. The system works effectively and continuously and future expectations require effective management. The preparation of a system for electric energy requires knowledge of all the physical assets of the electricity distribution network for the purpose of identifying the nature of distribution and benefiting from this by making a strategic decision, so data must be collected and spatially analyzed.

The use of GIS technology to create a spatial database system, manage it on-site and produce it in the form of maps through which a picture of the spatial relationship between the distribution of the electrical network and the customers who benefit from this network can be given. Clarifying the nature of the system and its uses for the purpose of identifying the amount of energy currently consumed, as well as the amount of consumption will also appear at the level of the residential neighborhood, which gives an indication of determining whether the transformer is overloaded or still working with the capacity allocated to him.

Research objectives spatial distribution of the electric power grid and its services.
- The nature of energy supply at the district level and the spatial relationship between the transformer and the consumer.
- The extent of the shortage in energy supply.

2. Study area
The study area (Tal Afar) is located northwest of the city of Mosul, at a distance of 69 km and at an altitude of 370 m above sea level. As for the astronomical location, Tal Afar has a good geographical location from this direction 22°36’ North (see Figure 2) [2]. There is in the city of Tal Afar, the Tal Afar National Station, with an area of (22500) square meters, and it is located in the military quarter, with a capacity of 3 * 63 megawatts. This station can supply 56 megawatts as a maximum load currently for the city of Tal Afar [3].
3. Articles and Method
1- Tal Afar Electricity Department data
2- Satellite image
3- Transformer details
4- The number of clients connected to the transformer
5- The energy consumed by each customer
6- Software
7- ArcGIS 10.4
All the land uses in the city were signed to represent in the form of layers such as buildings and the road network in the form of polygons and lines, as well as the electrical power grid as well as power transformers in the form of points and the service lines and customer contact point were numbered. The distribution network map and data were built that show the spatial location of the transformer, as well as the spatial relationship between all the network lines and their connection to customers.

4. Results and Discussions
Figure 3 shows the nature of energy distribution to the consumer to which customers communicate with service lines, the spatial location of electrical power transformers, and power stations, as well as the use of land in the city and the boundaries of residential neighborhoods.
Figure 4 shows the nature of the electricity flow from the transformer to the main, from the distribution stations to the sub transformers and then to the consumers (residential neighborhoods). This indicates the customer's connection to the distribution network. The total number of buildings served by the converter can be determined from the attributes of this building (Figure 5) in the database. Through the apparent variation in the color variation from dark to light, the darker color indicates the highest energy consumption level, while the lighter color shows the lowest energy consumption level. The energy consumed by each customer as well as the total energy consumed by the entire region related to the swelling.

The features of the city's residential neighborhoods can be clearly identified (Figurse 5-8). This will help the city's electricity department to find out where the deficiencies in the supply of energy are, as well as they can expand or improve their services, as well as residential neighborhoods that suffer from a lack of supply and that are seeing pressure on power transformers to supply them with transformers of greater capacity.

This leads in most cases to the detonation of electrical transformers or fluctuations in the supply of energy through the transformer, high or low. The size of the transformer determines the level of energy it carries; the more it loads the more energy it carries and the less energy it carries. Verify the validity of Figure 5 by showing the numerical value of the equipped energy for each transformer by residential neighborhoods.
Figure 4. A map showing the customer's connection to the distribution network

Figure 5. Table of features of the energy system
Figure 6. A map showing the level of energy consumption for each neighborhood

Figure 7. A map showing the spatial distribution of the power transformer, according to the production capacity of each residential neighborhood
Through the central transfer station in the city, the shortest path accessible to consumers can be determined, which means reducing the length of the network connection that leads to a decrease in voltage due to the long distance covered in the distribution of energy. This also helps us to calculate the voltage drop and power loss of a certain length such as the exact coverage distance can be determined from the analysis of the distribution lines.

Through analysis, we can determine the best location of the transformer as well as a central location with respect to the loading area that is provided as this reduces the length of the distribution lines connecting the transformer to the load and reduces the number of the electrode. This reduces the cost of the cable and also reduces the distribution losses. This indicates that 45 housing units are connected to the transformer with a minimum consumption of 0.4KW and a maximum of 6.9KW, the average consumption rate of 2.1KW with a total consumption of 525.6 KW.

With a throttle of 357 - KW, the total power consumed by all customers is compared to the capacity of the transformers. 376 transformers as shown in the transformer attribute table (Figure 9), it can be seen that the transformer capacity is in proportion to its power. With this result, it will be easy to decide on the number of transformers of low capacity.

Thus, the use of geographic information systems techniques, through which an efficient electrical energy distribution system can be worked out. Also, GIS allows the creation, maintenance, and query of an electrical database to generate information using the added ability to analyze spatial data. Through an attribute, location analysis, or spatial modeling, the user can query any layer of the GIS map to obtain attribute data for a specific feature of that layer. The user has to click on any feature for a specific layer to obtain the feature for that feature as shown in Figure 9 and Figure 10. GIS can also be used to monitor energy loss as a result of measuring inaccuracies in the distribution sector by knowing the total number of consumers who use payment meters and also those who do not use energy meters at all. This system provides an accurate way to limit the evasion of payment and obtain accurate information on these evaders of payment.
5. Conclusions and recommendations

The use of modern technological systems to improve the work of the distribution of electrical energy depends on the selection of the most effective and appropriate system with correct and accurate operating practices. Therefore, it is not sufficient to analyze the current and temporal processors, but rather the analysis consists in building planning alternatives for the future demand for energy. Since the network is on the surface of the earth and has accurate coordinates, it is possible through these coordinates to re-output it with maps that can be updated and monitored continuously, and then divide
the information in the map into layers containing a database of details of consumption, bottlenecks and future demand.

GIS is a simulation of the real world after entering the relevant spatial data and conducting spatial analyzes, to reach high-resolution results.

GIS technology can be used in data management, which saves time, effort and cost, and is of high accuracy.

Now we need a very big need to spread the culture of using modern technology in managing the distribution system as well as higher education to create greater awareness at all levels of government through the media and training cadres in all government authorities to reach an electronic government.

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