

***POWER DISTRIBUTION NETWORK BASED ON
GIS AND GPS TECHNIQUES***

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Electricity is an essential part of our everyday lives that we often take for granted. We take it for granted that is until we have to do without power for one reason or another. We don't often actually see them, but behind the scenes many people are working to ensure that we have a clean, safe, reliable source of power, that we don't have unpredictable or inappropriate current is there when we need it; and that it is, more or less reasonably priced.

But unfortunately in our Indian scenario, the Central Power Distribution Company could not able to supply enough power to the people due to high population, low power generation, transmission and distribution losses and illegal service connections of consumers. To overcome this problem they have to mainly reduce the power losses and to prevent the illegal operations of consumers. For that the electrical Distribution Company is responsible to manage the distribution system safely and efficiently, which deliver electric power from AreaFeeder to Outservice drops. In India, the main drawbacks of the distribution system are poor maintenance of the installed facilities, lack of proper planned network, lack of monitoring and prevent losses and manual updations of consumer records etc. Today's electric utilities are realizing the benefits of geographic information system (GIS) technology in the management of facilities for Engineering, Construction, Operations, Maintenance and Services purposes. Electrical Distribution model supports these typical business needs by providing an implementation that focuses on operations and maintenance portions of the facility life cycle and provides a crucial visual component.

Hence there is a need to study the existing power distribution network system available and purpose a strategy to develop an application. With the above thought the topic " POWER DISTRIBUTION NETWORK BASED ON GIS AND GPS TECHNIQUES " was taken into consideration.

AIM AND OBJECTIVES:

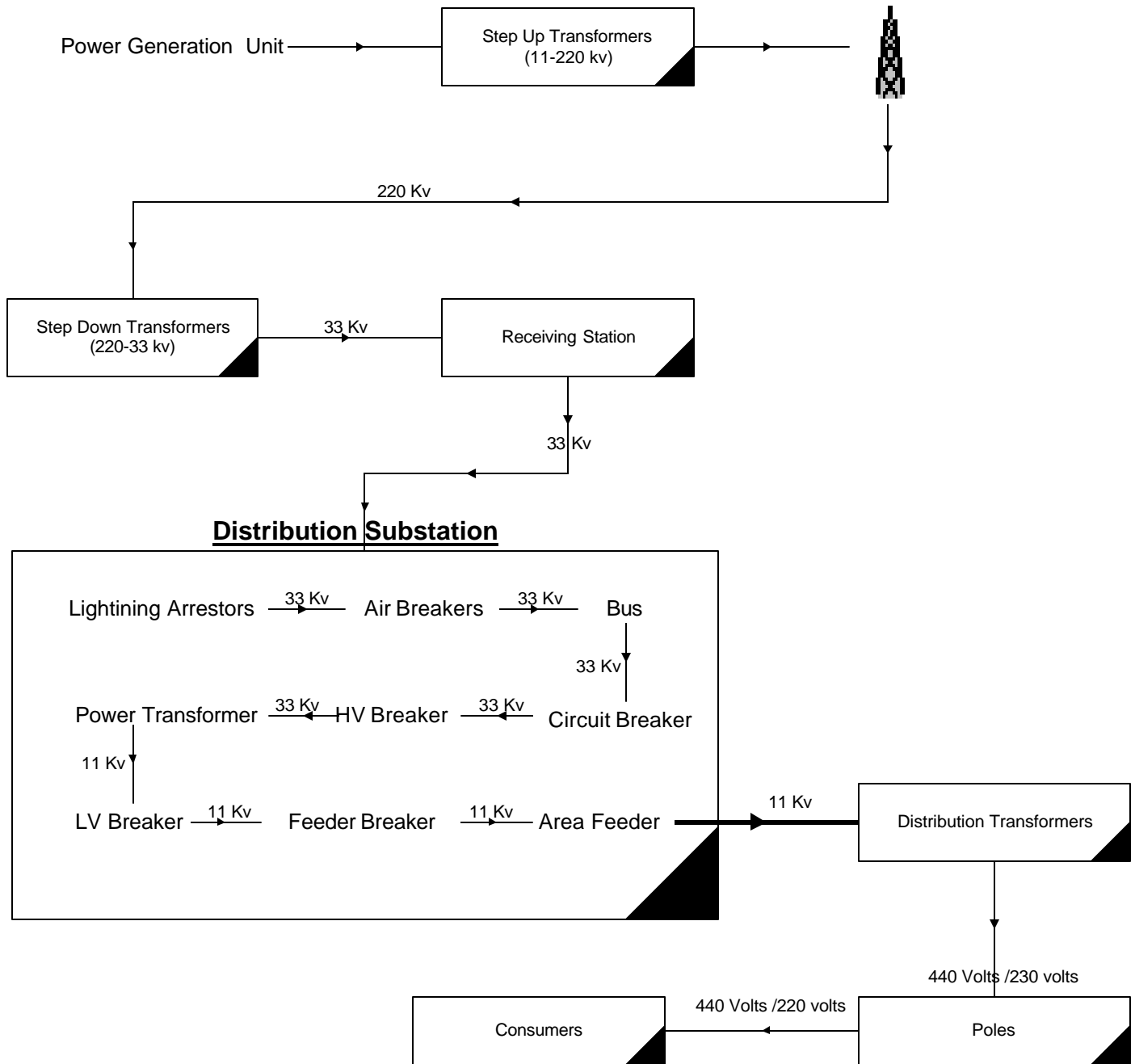
To develop an Electrical Distribution Network using GIS and GPS observations and develop an application.

- ✍ ✍ Study of the existing electrical distribution network
- ✍ ✍ To create an electrical network using with GPS data
- ✍ ✍ Study of the existing GIS packages for customization of electrical network application using GIS as a tool.
- ✍ ✍ Understanding the Business process flow of Power Distribution Network
- ✍ ✍ The design of database to minimize the data redundancy and effective functioning of the application
- ✍ ✍ Customization of the software to fulfill the application needs

STUDY AREA :

TO achieve the above objectives, one substation namely Medi city has been taken. Medi city area is a part and parcel of Hyderabad in Andhra Pradesh state, which lies in the Survey of India Toposheet 56k/16. This total substation is having three feeders namely, Raja Bollaram, Medicity Hospital and pudur. The area covered for medicity substation is 56 kms. From this 33/11kv substation levels, consumers can directly take electricity through the Transmission Network System. So the study of one full substation and its network has been taken.

Power Distribution And Transmission System



The Figure shown in this page explains the flow of electricity from the Generation to the Consumers.

MATERIALS AND METHODOLOGY:***GPS Observations***

GPS receivers that are capable of recording co-ordinate data for post-processing.

☞ GPS Receiver (wgs-84 coordinate or longitude, latitude, altitude)

☞ Better accuracy in case of PDS

Attribute information from Electricity department.

Medicity substation attribute data which has three feeders have been collected from electricity department. For each feeder, distribution and power transformer details, HLVpoles, HV poles, LV poles, circuit breakers information has been collected.

The details about the Consumer name, Plot Number, The transformer code and its poles codes from where the consumer is drawing power, Usage category, Meter number, Meter Make and the Meter readings of the consumer have been collected from department. The information details about the transformers have been surveyed and updated.

Systems and Software:

?? ARC INFO 3.5

?? ARC VIEW 3.2.a

?? VISUAL BASIC 6.0

?? MAP OBJECTS

?? MS-OFFICE-ACCESS AND EXCEL

METHODOLOGY:

The first process that includes the collection of pole and transformer locations for all the three feeders of Medicity substation, with the help of GPS instrument. The second process that includes the development or generation of network(point and line) by using the GIS software. The final process involves an application development using with Visual Basic and Map Objects.

GPS Survey:

The process that involves while collecting the data from GPS is as follows.

Static GPS surveys:

Static GPS survey procedures that allow various systematic errors to be resolved when high accuracy positioning is required. Static procedures are used to measure baselines between stationary GPS receivers by recording data over an extended period of time during which the satellite geometry changes.

Satellite Geometry:

Satellite geometry factors which must be considered when planning a GPS survey are:

- i. No. of satellites are available.
- ii. Minimum elevation angle for satellites
- iii. Obstructions limiting satellite visibility
- iv. Position Dilution of Precision(PDOP)

Network Design:

Base lines (vectors): Base lines developed by processing data collected simultaneously by GPS receiver at each end of a line. For each observation session, there is one less independent base line than the no of receivers collecting the data simultaneously during the session. The Base lines should be the series and continuous connection e.g. power supply. The diagram shows the connectivity of the vectors, each individual line is connected to a single continuous network. As power is continuous in connection with its supply the network and each vectors location is also continuous up to where it ends the line.

Networks: Each station in a network must be connected, with atleast two independent base lines. Avoid connecting stations to a network by multiple baselines to only one other network station.

Field Procedures:

Proper field reconnaissance is essential to the execution of efficient and effective GPS surveys. Reconnaissance should include:

- ? ? Station setting or recovery
- ? ? Checks for obstructions and multipath potential

- ? ? Preparation of station descriptions (monument description, to-reach descriptions for azimuth pairs, etc.)
- ? ? Development of a realistic observation schedule.

Station Site Selection:

The most important factor for determining GPS station location is the project's requirements (needs). After project requirements, consideration must be given to the following limitations of GPS:

- ? ? Stations should be situated in locations that are relatively free from horizontal obstructions. In general, a clear view of the sky is required. Satellite signals do not penetrate metal, buildings or trees and are susceptible to signal delay errors when passing through leaves, glass, plastic and other materials.
- ? ? Locations near strong radio transmissions should be avoided because radio frequency transmitters, including cellular phone equipment, may disturb satellite signal reception.
- ? ? Avoid locating stations near large flat surfaces such as buildings, large signs, fences etc., as satellite signals may be reflected off these surfaces causing multipath errors.

With proper planning, some obstructions near a GPS station may be acceptable.

Weather Conditions:

Generally weather conditions do not affect GPS survey procedures with the following exceptions:

- ? ? GPS Observations should never be conducted during electrical storms.
- ? ? Significant changes in weather or unusual weather conditions should be noted in the observation log(field notes). It is generally to be avoided during periods of significant weather change.
- ? ? In general a clear view of sky is required to collect the satellite data within its locations and without having any errors.

Documentation:

Generally, survey report includes the project requirements. The final field survey report should include this following information:

- ? ? The X,Y,Z co-ordinated locations must have been collect and mention in its Longitude, latitude and altitude respectively., in the columns mentioned from the GPS observations.
- ? ? No. of satellites that are visible at the time of data collection.
- ? ? The existing features such as transformer and its code details and pole information should mention in the description part.
- ? ? Each pole and its connectivity towards the transformers and feeders and substations like wise...and poles connectivity should be clearly mentioned. And a rough diagram or mapping of poles network should be drawn for clear understanding of the field, which would be later more useful when generating its Locations on Arc Info.
- ? ? Locating Transformers, HV Poles, LVPoles, HLV Poles, Plots

GPS is the best tool available for positioning and can economically replace the existing practices of survey, monitoring and therefore should be adopted by Central Power Distribution Company early. GPS system is controlled by the United States and is capable of even selective degradation in accuracy.

GPS Integration with GIS for Network

The GPS survey data has been processed in ms-excel. The X,Y locations i.e longitude and latitude, which is the important feature has been converted from degrees, minutes seconds to decimal degrees, that which Arc Info supports the creation of co-ordinated network. The mapping of point and line features has been generated separately and editing has been done for its proper and exact location of poles and transformers in Arc Info. Like wise, all H.Ts and L.T lines under each feeder has been created and converted them into shape files. Medi city Substation which is having three feeders namely Raja Bollaram , Medicity Hospital and Pudur have been converted into shape files which were be the supporting files to the ArcView and Map Objects.

In Arc View, Transformers both of H.Ts and L.Ts located with unique symbols. The important work that include here the database creation. Codes given for identification of substation, feeders, each feeder transformers and its codes, pole codes was given and updated. These codes are main source in developing the application in Visual Basic.

Application Development using with Map Objects and Visual basic.

A separate database was created which is having the tables of Power and Distributed Transformers details, Pole details ,consumer details, meter details etc., Final application has been developed with various menus and screens and established the connectivity of database and shape files by writing the code. Final results have been shown as reports and forms.

The main steps that followed in the methodology to reach the objectives are appraisal of planning power network efforts, review of distribution system and problem identification, design and implementation and finally the results.

ANALYSIS AND RESULTS:

REPORTS, CHARTS AND QUERIES

The results are in the form of display, reports, queries and forms etc. and providing the customer information services through the electrical call center. This application satisfy the needs of Power Distribution Company such as

- ☞ ☞ Power Distribution Network that maps the flow of Electricity from the Area feeder to Substation, Substation to the Distribution Transformers and from the Distribution Transformers to Poles and from Poles to the Consumer.
- ☞ ☞ To know the load growth of the geographical area served by the substation for optimal substation allocation and transformer sizing.
- ☞ ☞ To maintain the installed facilities, to plan new facilities, to know the potential trouble spots for the network or potential trouble areas.
- ☞ ☞ Searching on consumer by query, geography and electrical path and providing the customer information services.

ELECTRICITY CALL CENTER (ECC)

The purpose of enabling complaints acceptance is to provide better service to the Company's customers by allowing them to register their complaints remotely by calling up a centralized phone number on a 24/7 basis (24 hours a day and 7 days a week).

a) *Receipt of Complaints*

When a customer calls the Center, the call would be attended to by operators' in-charge. They would register the complaint against the Customer's SCNo., name and address and provide him with a unique complaint number.

b) *Dispatch of Complaints*

Post receipt, the complaint would be forwarded to operators in-charge of 'dispatch'. These operators would have telephone lines that are different from those used by operators receiving complaints. They would also have a mapping of different Substation/ SO phone numbers against each customer address/ locality for ready reference. The dispatch operators would call up the appropriate 'attendants' (at the Fuse off Call Center, Sub-station, Section Office etc.) to communicate the complaint details. These attendants would in turn forward the complaint to the concerned Linesman/ Assistant Linesman etc. for complaint resolution. These attendants would provide the ECC operator with a 'reference number' indicating that the complaint has been registered by him.

c) *Reporting*

To monitor the operations of the Electricity Call Centre, some personnel would be in-charge collecting relevant data and generating reports on operations. These could include tracking the number of cases resolved, reasons for not resolving outstanding cases etc.

The complaints entertained at the ECC would include :

- ✂ ✂ Supply failed – Total area
- ✂ ✂ Supply failed – Individual
- ✂ ✂ Supply failed – 1 phase out
- ✂ ✂ Dim supply
- ✂ ✂ Voltage fluctuation
- ✂ ✂ Blinking
- ✂ ✂ Transformer – Smoke/Flames
- ✂ ✂ Transformer – Cable/ lugs burst
- ✂ ✂ Transformer – Sparking on the pole
- ✂ ✂ Transformer – Oil leaking
- ✂ ✂ High Voltage
- ✂ ✂ Low Voltage
- ✂ ✂ Line – Snapped
- ✂ ✂ Line – Bunched/ Twisted
- ✂ ✂ Line – Tree branches touching
- ✂ ✂ Pole – Shock
- ✂ ✂ Pole – Leaning
- ✂ ✂ Pole – Fell down
- ✂ ✂ Pole – Rusted/ damaged
- ✂ ✂ SC – Wire broken
- ✂ ✂ SC – Wire damaged
- ✂ ✂ SC – Wire loose connection
- ✂ ✂ Replacement of damaged service wire
- ✂ ✂ Street lights – Rectification of line faults
- ✂ ✂ Meter running – Fast
- ✂ ✂ Meter running – Slow
- ✂ ✂ Meter Stuck up
- ✂ ✂ Replacement of defective meters
- ✂ ✂ Replacement of burnt meters etc.

CONCLUSIONS:

From this study undertaken, it is found that a complete information system for the Power Distribution Company and the department can be used in many ways to improve the planning, maintenance and management standards of the department. It can be used to achieve following things efficiently:

✍✍ This study has proved that an updated complete information is required for identification of the consumers.

✍✍ A Database management system integrated with Geographical Information System can help find solutions like identification of each and every consumer and their locations with their connectivity in the area.

✍✍ This GIS based system helps in not only identification of each and every plot location but also provides complete information about the consumer.

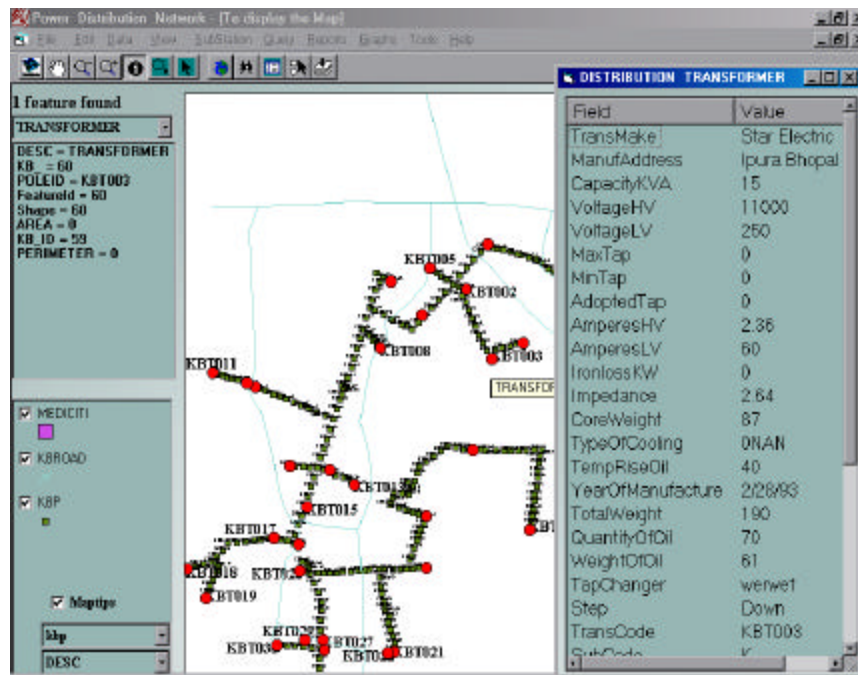
✍✍ This enables to go for carrying out analysis of each and every consumer bills payment and to find the average annual distributed power and utilized power.

✍✍ The GIS based system thus helps to perform different types of analysis such as Load analysis, location analysis, network analysis, problem identification analysis etc.

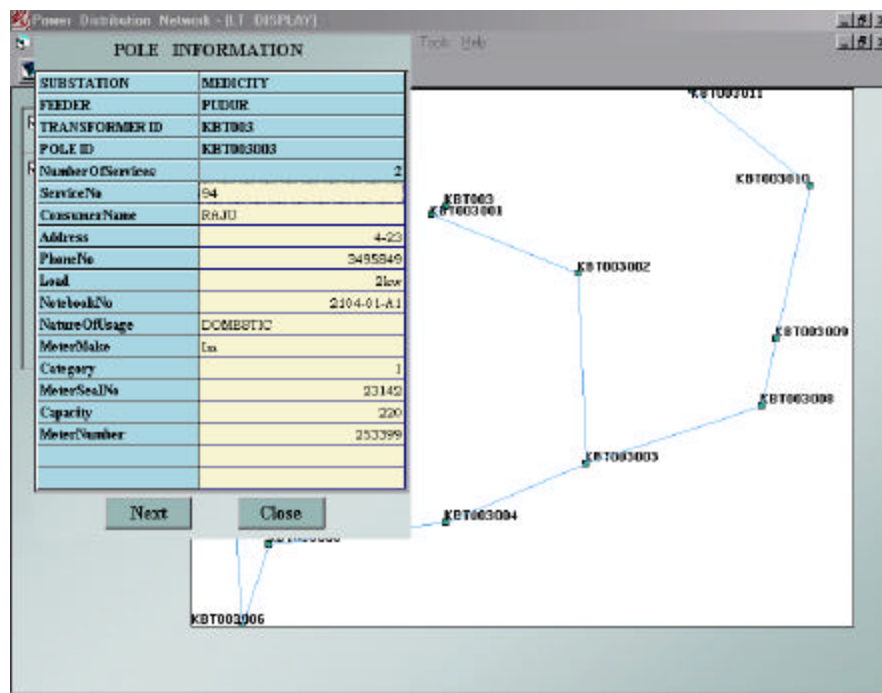
The GIS based system help the company to find the shortest route from the office to problem location. This is found very much helpful to the lineman of the department in carrying out their surveillance work by identifying and reaching their place very easily and even in less time even though they are not familiar with the place.

The software development begins with the creation of menus, master entry forms and transaction entry forms with respect to the application. Implementation, testing and evaluation are an important and crucial moment in the development of any information system. The management should be totally satisfied with the working of the system. The PDS has been successful in this phase and the system will satisfy the needs of the management working with this system as this is very much user friendly. The management can operate this system very easily even though management is a computer illiterate.

DETAILS OF DISTRIBUTION TRANSFORMER



POLEWISE INFORMATION



POLE CODES - LOCATION

