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# APPLICATION OF GIS TECHNOLOGY IN ELECTRICAL DISTRIBUTION

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*ABSTRACT*

***Electric utilities have a need to keep a far reaching and exact stock of their physical resources, both as a piece of ordinary administration arrangement (expanding the system, undertaking upkeep, and so forth.) and as a piece of their commitment to educate outsiders about their offices. Unpredictability of electrical dispersion control framework is a justifiable reason explanation behind presenting new data innovation - GIS (Geographic Information System) that completes complex power framework examinations (e.g., blame investigation, enhancement of systems, stack estimating) in adequate measure of time. By utilizing present day GIS, in conjunction with his own in-house created programming, in not so much time but rather more precisely, the utility designer can plan and to dissect electrical dissemination organize. This paper exhibits the possibility of the venture CADDiN© (Computer Aided Design of Distribution Network) as of now a work in progress at the Power Systems Department of the Faculty of Electrical Engineering, University of Zagreb.***

***KEYWORDS*: GIS Technology, Application, Electrical Distribution, Power System.**

## INTRODUCTION

One of the essential commitment to the progressions and changes in man's way of life throughout the years has been the capacity to utilize and control vitality. Man's utilization of vitality can be seen in regular operations, for example, mechanical movement and the creation of warmth and light. A lot of energy are produced at control plants and sent to a system of high-voltage (400, 220 or 110 kV) transmission lines. These transmission lines supply energy to medium voltage (e.g. 10 or 20 kV) circulation systems (dispersion essential framework), which supply energy to in any case bring down voltage (0.4 kV) dissemination systems (appropriation auxiliary framework). Both conveyance organize lines supply energy to clients straightforwardly. In this manner, the aggregate system is a mind boggling network of interconnected lines. This system has the capacity of transmitting power from the purposes of age to the purposes of utilization. The conveyance framework is especially vital to an electrical utility for two reasons: its closeness to a definitive client and its high speculation cost. The goal of appropriation framework arranging is to guarantee that the developing interest for power, with developing rates and high load densities, can be fulfilled in an ideal path, for the most part to accomplish least of aggregate cost of the circulation framework extension. Thusly, the appropriation framework organizer parcels the aggregate dissemination framework arranging issue into an arrangement of subproblems that can be taken care of by utilizing accessible, typically heuristic strategies and procedures [T.Gonen, 1986]. The outline of electrical appropriation systems is an ordinary undertaking for electric utility architects, uniquely in R&D office. Such plan was completed couple of years prior physically. This traditional approach generally result in overdesign dispersion framework, which is currently considered as a misuse of limit that can be utilized as opposed to putting resources into framework development. Four years prior a PC program bundle (CADDiN©) for ideal arranging of circulation organize was placed in

operation in Elektra - Zagreb (Electric Utility of City of Zagreb). It is an aftereffect of joint R&D of Power System Department of Faculty of Electrical Engineering and Elektra - Zagreb. In light of the experience or PC-CADDiN©, toward the end or 1992. the model of new venture CADDiN© was begun reasonably composed as a piece of the Geographic Information System.

## THE ROLE OF GIS IN DISTRIBUTION NETWORKS

Database assumes a focal part in the operation of arranging, where investigation programs frame a piece of the framework upheld by a database administration framework which stores, recovers, and alters different information on the dispersion frameworks. The thing that recognizes an electrical utility data framework from an other data framework -, for example, those utilized as a part of saving money, stock control, or finance frameworks - is expected to record geological data in the database. Electrical service organizations require two sorts of topographical data: points of interest on the area of offices, and data on the spatial interrelations between them. The joining of topographically referenced database, logical instruments and in-house created programming apparatuses will enable the framework to be outlined all the more monetarily and to be worked considerably nearer as far as possible bringing about more productive, minimal effort control appropriation frameworks. Extra advantages, for example, enhanced material administration, stock control, preventive upkeep and framework execution can be proficient in a deliberate and financially savvy way (Z.Sumic, et al, 1993). Before graphical workstations were created, numerous electric utilities have assembled specialized data frameworks in view of social database administration frameworks (E.Jorum, et al, 1993.). Specialized data framework is intended to cover the necessities of energy supply utilities considering system extension and operation arranging, upkeep administration and framework documentation. In cutting edge utilities all data frameworks are worked around same RDBMS and continually refreshed. Setting up joins between these data frameworks and topographical data framework is just in characterizing connection between objects in the two frameworks. The issue that has risen is in various distinctive data frameworks in a similar utility (specialized data framework, client data framework, and so forth.) or even a few covering specialized data frameworks and some of these are not refreshed.

## OBJECTIVE

The target of the dispersion organize configuration process can be partitioned into three free parts. These parts are:

Load guaging

1. load development of the geological region served by substation;
2. determination of load greatness and its geographic area;
3. customer load qualities; Design of optional framework (low voltage dispersion organize)
4. optimal substation portion and transformer estimating; optional hardware directing and measuring;
5. Design of essential framework (medium voltage appropriation organize)
6. optimal substation designation;
7. primary hardware directing and estimating;

To diminish an issue unpredictability each piece of the outline procedure is partitioned in utilitarian subproblems. Each of these subproblems can be then considerably less demanding to oversee. Albeit just free a few sections of configuration process interface, i.e. situation of substation will impact optional directing which thusly will impact essential steering. The quantity of conceivable outline arrangements that may fulfill a given arrangement of spatial, specialized and monetary limitations is very various. Various, reliant objectives and requirements make traditional procedural improvement strategies wrong for dispersion organize plan. Because of the multifaceted nature of the plan procedure, heuristic strategies and AI methods must be connected to discover "close ideal" [S.Krajcar, 1988] or "fulfilling" arrangements [Z.Sumic, 1993]. The fundamental purpose behind this improvement is with respect to work-power and PC time for finding ideal arrangement that in high rate couldn't be pertinent in genuine circumstance.

## GENERAL DESCRIPTION OF GEOGRAPHIC INFORMATION SYSTEM OF PROJECT CADDIN

Pilot-venture CADDIN was begun toward the start of 1993 as an examination venture inside the primary research venture "Innovative work of Electric Power System" bolstered by the Ministry of Science and Technology of the Republic of Croatia. The improvement of enhancement and plan techniques of electric appropriation arrange is a parallel procedure with building database by Cadastral Office of the City of Zagreb, and subsequently some other accessible cases of essential guide databases are utilized for explore purposes (see Figure 1). The system utilized underscored just the information made out of essential guide databases for specialized applications (sizes of 1:500 to 1:5000). There is no interesting definition for Geographic Information System (GIS) yet a normally acknowledged one is that it is a framework with PC equipment and programming capacities for the spatial information input, stockpiling, examination, and yield [T. Bernhardsen 1992]. Numerous course reading definitions go further and distinguish examination as the one movement which separates GIS from other PC based frameworks for taking care of geographic information, for example, computerized cartography.

Current GIS, stores data on the geometry, properties and topology of geographic highlights in one social database administration framework. Framework 9 utilized as a part of the pilot-venture CADDiN is a component arranged GIS which sorts out topography related data into a topology-organized, protest situated, social database framework. An undertaking is the most elevated amount of information association of GIS utilized as a part of CADDiN [Computervision, 1992]. It speaks to the whole database that has been set up for a specific geographic zone - for instance, a town, a region, or an administration area. It involves two parts: an information store that contains all the geographic and ascribe information identifying with highlights; and a database definition that indicates the structure of the undertaking through component classes and subjects.

Subject definition figures out which highlights and credits are to be utilized and the manners by which are to be shown. Freely put away geometry of a component, and its realistic portrayal empowers position and illustrative information to be changed without reference to each other. The connection between the geometry and the portrayal is given by the subject. It includes a rundown of highlight classes, include class properties, and a connection to a different rundown of realistic changes. A critical wellbeing part of utilized GIS is that it doesn't enable clients to roll out improvements to the database at venture level. A client may just inquiry it. The database is made and refreshed by methods for the following lower level of information structure: the parcel. This is a replicated, working subset, or part of an undertaking. It is at this level a client associates with the framework to enter, alter, refresh and control information. Segments are removed from an undertaking in view of the kind of work to be done and the information that will be required to play out that work. When altering is finished, the parcel is converged into the undertaking database, affecting the refresh. Parcels are made by methods for a segment definition that portrays the spatial degree, the substance, and the portrayal. The framework utilizes the parcel definition to extricate the required geometric and trait information and after that designates them into the required segment. The value of the segment

structure is that it enables distinctive offices inside an association to work securely on the information from a similar venture.

Every single geometric element in the information display are developed from geometric natives, alluded to as hubs, lines, surfaces and spaghetti. A hub is put away as an arrangement of X, Y, and alternatively Z facilitates in 3D database, and may be utilized to speak to e.g. transformers, switchgears, MV - LV transports, and so forth. A line crude is a geometric component characterized by two end-hubs (permitting middle of the road focuses), and may be utilized to portray transmission lines, links, and so on. A surface comprises of at least one line fragments that together shape a shut polygon. A timberland, lakes, stops, a bit of system, or territory secured by a great deal of structures could be depicted by this sort of polygon. Spaghetti empowers to display highlights where no topological structure is required. Hubs are the main geometric natives that have facilitate data straightforwardly connected with them. Lines are not characterized as far as geographic directions, but rather by pointers to their topological hubs. Surfaces are characterized by pointers to the lines encompassing the surface. Every one of these pointers are made and looked after naturally.

Geographic articles are put away as accumulations of hubs, lines, surfaces or spaghetti, however they can be alluded to as geometric natives and also some gathering of items which can be recognized and named in reality - 'streets'. 'links', 'transformers', structures', et cetera. These classifications are spoken to by `feature classes'', and the individual examples of geographic questions as `features'. Such highlights finally comprise of at least one geometric natives. All highlights inside a specific component class will have the same topological structure, and a similar arrangement of traits.

Highlight classes could be additionally recognized as items in groupings of related articles that might be set up based on area, spatial connections or normal properties. These coherent groupings of highlights are called complex highlights. They are characterized as highlights that contain different highlights. Every single complex element of specific sort, contain a perplexing component class. A helpful use of complex element order would be in shaping legitimate groupings, for example, MV transport, transformer, LV transport, insurance gadgets into 'substation'. Complex highlights can likewise have qualities related with them (for instance name, number). It would kill copying of highlight credits which legitimately identify with the substation. Meaning of complex element isn't limited to incorporate just basic highlights as constituent segments. For instance, 'dispersion arrange' could be characterized as an unpredictable element containing various 'substations', 'links', which are themselves complex highlights. A quality of this approach is that it can be utilized to limit the level of information excess of both trait and geometric data. Clients cooperate with the database through a question handler, and they are aided that communication by an organized inquiry dialect that joins expanded spatial and reference administrators.

Behind expository apparatuses accessible inside GIS condition, an arrangement of independent capacities is accessible from UNIX shell. This arrangement of capacities is called Application Tool Box (ATB). ATB offers a domain in which information can be overseen straightforwardly, without first extracting importance from outline of those information. Under this approach a client can create expository models as indicated by particular necessities by mix of ATB capacities, in-house created programming (C and FORTRAN projects) and shell programming. To accelerate complex examination by Development Libraries of ATB new handling elements of ATB could be produced. Utilizations of undertaking CADDiN are creating by ATB works in conjunction with C and Corn shell programs.

ATB information administration and review contain handling capacities, dataflow administration and designs seeing framework. Handling capacities play out the genuine examination operations on sets of information called information streams, each of which compares to a social table in the database. All control of information streams

happens in an exceptional impermanent work region called a clipboard. Handling capacities include the accompanying operations: data administration (i.e. choosing data from database and putting it into a dataflow, speaking with outer programming bundles), characteristic handling (i.e. producing values for characteristics in view of grouping standards or recipe), geometry preparing (spatial capacities - union, contiguous, and so on.) and number juggling handling (i.e. ascertaining the region of surface substances, or length of direct elements). Dataflow administration is utilized to make, show and erase information streams and perspectives. Realistic review framework enables client to see the transitional or last outcomes and produce a plot of those outcomes.

Good to ATB capacities are independent elements of Network Trace Analysis module. By those capacities arrange following can be done utilizing the data on organize network and segment attributes that are as of now put away in database. Unique capacity is utilized for arrange age that is put away as dataflow on the clipboard. On this dataflow a few systems following capacities can be performed (way enhancement, extend discovering, way finding) or can be utilized by outside programming. Because of that examination a dataflow is delivered on the clipboard. Unique and resultant systems can be questioned at the same time. The client can keep or erase coming about information stream on the clipboard or recovered in database.

## OPTIMIZATION OF DISTRIBUTION NETWORKS IN GIS

Ideal Location of TS x/0.4 kV in Secondary Distribution Network

The methodology for finding ideal design of optional framework comprises of two conceivable enhancement steps:

1. optimization of new territory auxiliary framework and
2. optimal association of the specific customer(s) to existing auxiliary framework.

With respect to plans, environmental and tasteful requirements and additionally past load development investigations conceivable areas of substations are known ahead of time. These suspicions make arranging of auxiliary framework more basic on the grounds that lone directing procedure must be connected for a few areas of substations and settled areas of clients.

The initial step of steering process starts by associating client to the closest directing passageway. After that technique, the auxiliary framework arrange is created by organize module. On this system "any way investigation" is connected and as aftereffects of examination there are altogether conceivable associations amongst substation and clients. These outcomes are utilized as contribution for outer, CADDiN module of advancement of spiral organized systems. Amid this procedure of improvement the arrangement of tenets is utilized to fulfill standard practices utilized by fashioners. The advanced system is then saved money on clipboard in dataflow and can be graphically seen. The cost for the auxiliary framework is fundamentally the capital venture cost comprising of link laying expense and cost of links. For every area of substation advancement process must be rehashed. Arrangement with negligible speculation costs and acceptable specialized imperatives is the best in regards to auxiliary system. All arrangements that are in fact fulfilled must be considered amid the essential system improvement. It is important in light of the fact that the nearby ideal of auxiliary framework does not suggest the ideal of essential framework, and worldwide ideal of circulation arrange.

The ideal association of the specific client to existing auxiliary framework must satisfy next two specialized and prudent limitations:

1. the most brief conceivable length of association because of voltage drop that might be allowed;
2. reserve in stack limit of substation because of client stack.

The new client must be associated with the closest neighbor client fulfilling already said requirements. The few closest clients are found in a cradle zone with new client as a focal point of this zone. The most brief way between new client and conceivable association hub is found in two stages: the two hubs are associated with the closest directing passage, and after that by GIS arrange work "discover best way examination" most limited way between hubs is found.

Ideal Structuring of Predefined Primary Distribution Network Configuration

Because of the heap attributes, asked for accessibility and nature of vitality supply two fundamental designs of auxiliary framework are utilized as a part of ideal arranging There is a ring structure (beginning and consummation hub is the same HV/MV substation and steering hubs are MV/LV substations) and a connection structure (beginning hub is one HV/MV substation directing hubs are MV/LV substations and closure hub is other HV/MV substation). As to use of GIS innovation the streamlining strategy of these two system arrangements is fundamentally the same as. In enhancement process three unique issues are considered:

1. optimization of the new essential framework;

2. reconfiguration of the current essential framework with respect to predefined structure, and

3. reinforcement of the current essential framework with characterized structure by introducing extra limit popular hubs or including the new MV/LV substation in the system.

The primary issue is like the issues in improvement of optional framework. There must be known every conceivable association and separations between HV/LV substation (source hub) and MV/LV substations

(Request hubs) and themselves. In this manner, all system hubs must be associated with the closest steering hall. By "any way investigation" and heuristic calculations (by and by hereditary calculations are tried) introductory arrangement or "zero-emphasis" is created. After that by the union of GIS organize work "discover best way examination" and other heuristic techniques ideal arrangement is found.

The second issue is more entangled than the first on the grounds that current associations in arrange must be considered in improvement system. Something else, same systems are utilized as in the main issue. Case of this enhancement system can be appeared. In the third issue, advancement method is like the strategy of adding the new client to the second framework. Slight contrasts are in a method for associating new substation to the current system. In the essential framework, with respect to the requirement of unwavering quality of supply of vitality to the client, every MV/LV substation must have a plausibility to be provided from two sides. In this manner, the closest existing link between two substations must be found for the association of the new station, or the closest steering passageway by which the new station could be associated with the closest substations that are found in a cushion zone around it. At the point when a superior sort of association is discovered, arrangement is tried on a few specialized limitations (voltage drop, link and course stack, speculation costs, and so forth.).

Load estimating of TS x/0.4 kV

Little territory or spatial, determining is the forecast of both the sums and areas of future electric load development in a way appropriate for circulation arranging which truly implies with geographic determination sufficient for arranging another dissemination system or expansions to the current one. The technique depends on partitioning an utility administration territory into various adequately "little territories" and anticipating the future load in every one. This is typically refined by partitioning an utility administration region into either a network of consistently estimated rectangular "cells", or into "hardware arranged" regions relating to feeder or substation territories (H.L. Willis, 1983,1992).

Strategies for modernized little region stack determining, with respect to their information necessities and examination techniques, fall into three classifications:

- trending
- multivariate (multivariable)
- simulation.

Basically these strategies dissect over a significant time span stack development to recognize patterns, examples, or data about the procedure of load development that is then used to extend future load development. Slanting techniques require insignificant information (they work just with recorded load information, normally yearly pinnacle load) and PC assets, and are generally clear being used. Due to their straightforwardness and by and large the least costs, they were the most broadly utilized methods previously.

Multivariate techniques require significantly more information (chronicled loads, geographic and statistic information on clients and use) and substantially more broad PC assets, yet consequently they for the most part give more exact gauges.

Reenactment techniques notwithstanding chronicled loads require broad and far reaching information that incorporate land utilize type, geographic and statistic information on a little territory premise, transportation and other assorted variables that may influence stack development. They additionally require extensive PC assets and work-drive. Then again they offer points of interest in precision and investigation of load development under evolving conditions. As a result of their unpredictability and prerequisites reenactment models have been past the extent of numerous electric utilities. So far one can see that the idea of little zone estimating requires substantial utilization of modernized investigations and control of expansive amount of information. With its potential outcomes GIS is a magnificent mean for creating and applying reenactment estimate models. Obviously, there is no constraint to utilize GIS for inclining techniques, in any event for some quick subjective survey, or for short range (under five years ahead) expectations.

An administration zone of a substation might be characterized as an unpredictable component which contains bundles, structures on those packages, electrical associations for each building or client, existing interconnections between clients hookups and related substation and so on. Bundles, structures and boulevards are displayed as polygons, and cadastral part code is connected to them as one of the characteristics. Measurable and statistics areas in light of roughly parallel number of tenants and cadastral locale are polygons, as well. Second imperative data is address, displayed as intricate component class containing a road name and number. Polygonal examination and polygon handling, which is conceivable in GIS, and address as a typical connection empowers the organizer to decide a substation benefit zone and ascertain its zone. Through highlights' properties every essential client's information (yearly power utilization, yearly pinnacle loads, sort of clients, some uncommon demands and meddling variables, and so on.) are reachable. In that way it is conceivable to track sums and kind of vitality utilized by singular client, or substation benefit territory or some other area. Upon these data stack densities ($kWh/m^2$) or kWh deals per client can be registered.

Methodology with worked in bunching calculation recognizes gatherings (classes, groups) of clients with comparable past vitality utilization conduct. For dispersion stack guaging K-implies calculation [Hartigan, 1986] is suggested, with at least 6-year stack history [H.L. Willis, 1983]. The K-implies calculation scans for a segment, that is, an arrangement of bunches that limits the "aggregate distinction" between little territories and their relegated groups (the blunder of the parcel). It works by moving little regions starting with one bunch then onto the next. The pursuit closes when no such developments of little zones decrease the blunder esteem.

## CONCLUSION

This paper exhibits the idea of the pilot venture CADDiN for advancement of electric dispersion systems in view of GIS innovation. The design of CADDiN comprises of the heuristic strategies actualized inside GIS and procedural projects. In such a cross breed condition, the GIS main undertaking is to display "genuine", perform spatial investigations and guarantee the high exactness of enhancement systems.

The primary outcomes got by the model database and created methods empower that ideas and thoughts built up in this paper can be connected on the genuine issues that exist in the dispersion framework arranging.

## REFERENCES

1. Sinha, J. (2010): GIS Application in power distribution utility
2. Osuagwu C. C. (2008): Geo-spatial Information System for monitoring and analysis of Electricity Distribution.
3. Pickering, D.J.M and Bannister, D.H. (1993): Utility Mapping and Record Keeping for Infrastructure.
4. Raghav, (2006): Electrical Network Mapping and Consumer Indexing using GIS.
5. Kulkarni S. S.(2011): Improving Efficiency of power sectors by using GIS