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WTMS: A location intelligence´s tool.

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Abstract--- This work describes the development of a service that allows the creation of thematic maps from statistical information provided by the users and from the geographical base chosen by them. The services become a tool of Location Intelligence that allow to represent the statistical information available to people in a given geospatial area, that are open source and also available on line or being disconnected from the network.

A study of the different technologies of cartographic symbolization and of some of the most important IT tools that are in use at present for the generation of thematic maps was carried out.

As a result we obtained a tool that will support the decision making process and will give added value to information systems to which it will incorporate.

Keywords--- decision making process, geographical base, service, statistical information, technologies of cartographic symbolization, thematic maps.

I. Introduction

The creation of specifically application tools, which allow showing knowledge and state of the art of different knowledge areas is a sign of accelerated development of informatics; information systems and particularly Geographic Information Systems (GIS) are prove of this progress.[1]

GIS are specialized information systems differentiated by its capacity to manage spatially referenced information and also by allowing it's graphical representation; analysts maintain that more than 80% of decision taking involves some kind of spatial component. [2]

General purpose or reference maps were, until half of XVIII century, the main objective of cartography. The motive for geographers, explorers and cartographers until then was geographical knowledge of the world. After important breakthroughs in these chores, cartographers had the possibility to express social and scientific data into the maps, which led to the birth of Thematic cartography which's objective is graphical representation of these data, transforming them into cartographical symbols and its relations with anything affecting geographical space [3].

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"A thematic map is that which is designed to show particular characteristics or concepts. In conventional map use that term excludes topographical maps" [4]. Thematic maps are composed by a base map and a layer of thematic content.

The paper *Why Geography Matters to the Enterprise*, defines Location intelligence (LI): "Location intelligence applies geographical or spatial context to information to inform actions or responses to business opportunities. For example, consumers need access to locational information for product search and shopping, and businesses can gain insights from knowing the location of factors ranging from their own assets to competitors. In fact, there are location and geographic contexts to every element of business—and organizations overlook it at their peril". [5]

Thematics maps becomes a tools of LI that provides the ability to organize and understand information through a geographical perspective to facilitate informed decision making. This helps organizations align better with the realities of their market territories, and thus improves performance and results.

The fact that a GIS allows to show thematic maps makes it an even stronger tool because is possible evaluate how particular phenomenon are distributed in specific areas. The technology maps the geographic elements contained within an organization's data to expose patterns and relationships that may otherwise be hidden in a maze of numeric tables.

Through GIS, data is translated into a universal language, providing an analytical vantage point that no other tool can.

Whether it is to manage assets more efficiently, streamline service delivery, or identify new business opportunities.

II.Metodology

A. *Thematic map components*

A thematic map involves two components: geographical base or base map – generally a topographical map – and thematic content.

Base map: Is a somewhat resumed image of the territory onto which thematic content is desired to represent; it

provides spatial information to reference the particular phenomenon that takes place in that geographical space. This map must be adapted to the information that will be represented on it and must be designed taking into account the content of the final map [3].

Thematic Content layer: Is the graphical representation – on the spatial area that it occurs – of an event or particular characteristic [3].

Reading the thematic map resulting from integrating base map and thematic layer depends on the intellectual and visual integration capacity of the reader.

B. *Types of thematic cartographies*

Thematic maps are divided in two different groups considering the type of information of an event they bring: qualitative thematic maps and quantitative thematic maps.

When spatial distribution of a set of data classified by nominal scales is represented we are in presence of qualitative map; the reader cannot determine order or quantity relations with these data. On the other side, quantitative maps represent variations of a variable from a point to another of the geographical space, variable that generally is unique for this kind of map. Data is show at least in ordinal scale (more or less than) and generally in index and interval scales (how much more than) [3].

For the representation of thematic maps there are some techniques of cartographical symbolization developed, divided in qualitative data representation techniques and quantitative representation data techniques. Each technique have particulars that are briefly explained bellow.

1) Qualitative data representation techniques

a) Punctual Data Maps

Punctual data maps identify the phenomenon and situate it according its coordinates. Phenomenon have an unique spatial location (x,y) and an attribute that is represented on the map by symbols that cannot imply any kind of hierarchy.

b) Linear data maps

This kind of qualitative maps are used to represent phenomenon that have a defined linear shape like roads, rivers, travel routes, frontiers among others.

c) Superficial data maps

Superficial data maps give information about phenomenon distributed on superficial extensions.

2) Quantitative data representation techniques

a) Dot Mapping

The method is based on the representation of a uniform punctual symbol of the phenomenon considering its quantity.

b) Proportional symbols mapping

This technique allows the representation of demographic and economic quantitative data distribution through symbols or images of different sizes and is the most used in quantitative thematic cartography.

c) Isolines Mapping

A kind of maps that uses the graphic formula of isolines, gives quantitative information and reflects spatial distribution of a phenomenon with color schemes. They are made by coloring spaces between isolines, follow 'higher value, darker color' criteria.

d) Flow mapping

This kind of maps is used for showing the dynamics of certain phenomenon and can be quantitative or qualitative. The movement is symbolized by lines or arrows with variable width proportional to its importance and sketched considering drawing and joining points – origin and destination – of movement.

e) Choropleth mapping

They give qualitative information and reflect spatial distribution of a phenomenon through range or schemes of color, used to represent discreet phenomenon associated with enumeration units, generally administrative surfaces (countries, provinces).

f) Cartograms mapping

Cartograms are diagrams that show quantitative data associated with areas, and enumerating units are proportional to the represented data. This method gives information by distorting real surfaces, using each surface as a symbol proportional to the values.

III. WTMS (Web Thematic Map Service)

A. *Service specification*

During service specification process Web Map Service [6] and Web Feature Service [7] specifications were studied, both defined by Open Geospatial Consortium Inc (OpenGIS)

and by the norms [8-11] that keep similarities with the present paper.

Thematic map service produces a map formed by a base map and a thematic content layer through statistical information. As result a suitable image must be obtained to be shown in computer, as well as the map legend and these elements are transferred by HTTP protocol.

The service has three operations: *GetCapabilities* returns service metadata; *GetThematicMap* generates a thematic map and its legend from the data and parameters defined by the client; and *LoadMap* allows loading a previously generated thematic map and its legend. To access the operations of the service - locally or remotely – they can be invoked through an URL that contains the required parameters.

Figure I describes message exchange between client application and thematic map server depending on the petition.

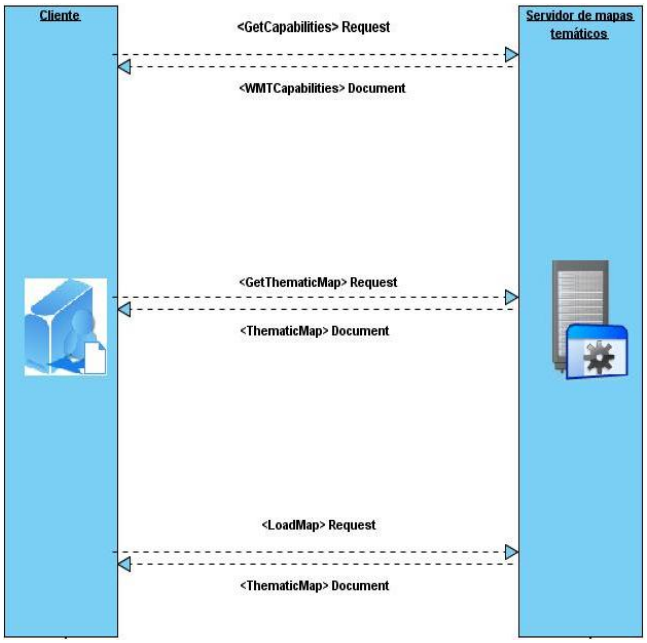

Figure 1. Message exchange between client application and map server.

B. *Developed service*

Was made a solution that allows generating the following types of thematic maps or cartographical symbolization techniques:

- Punctual data.
- Linear data.
- Superficial data.
- Dot Mapping.
- Proportional symbol mapping.

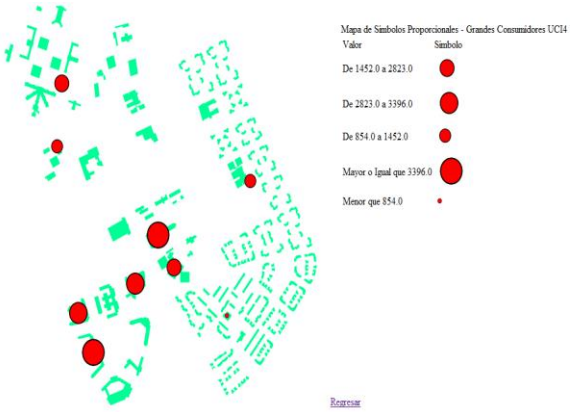

Figure 2. Proportional symbol map. Great electrical power consumers at the University of Informatics Sciences.

- Flow mapping
- Choroplets mapping

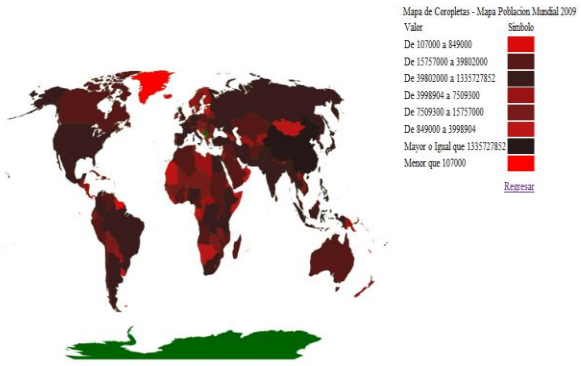

Figure. 3. Choroplet map. World population.

- Cartograms mapping

Figure. 4. Cartogram map. Mexico population.

Besides, the solution allows obtaining statistical data from differents sources:

- Spreadsheet.
- A table from a PostgreSQL database.

The obtaining of this diversity of thematic maps and the possibility of obtaining statistical data from different sources warrant the strength of the solution.

Solution operations –locally or remotely- can be invoked by URLs that contain required parameters for each operation, guarantying its accessibility been online or offline.

The solution code will be available for download and modification.

IV.Benefits

Location Intelligence is used by a broad range of industries to improve overall business results. Applications include:

- Communications & Telecommunications: Network planning and design, boundary identification, identifying new customer markets.
- Financial Services: Optimize branch locations, market analysis,
- Government: Census updates, law enforcement crime analysis, emergency response, environmental and land management, electoral redistricting.
- Healthcare: Site selection, market segmentation, network analysis, growth assessments.
- Higher Education: Student Recruitment, Alumni & Donor Tracking, Campus Mapping.
- Hotels and Restaurants: Customer profile analysis, site selection, target marketing, expansion planning.

V.Conclusions

Social and economical data integration with geographical has notable importance, due to allowing to see from another perspective statistical information, and that can result of great benefit from business managers to common people.

A solution that allows to generate most of the thematic maps that are used at global level is a step of advance in obtaining solutions of Location Intelligence that can reflect knowledge an information that people have.

Any information system that integrates developed service will allow a greater quality in services and will have a judgment element useful for decision taking.

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