ENGINEERING METHOD

GMAPS APPLICATION WORKSHOP

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Engineer design

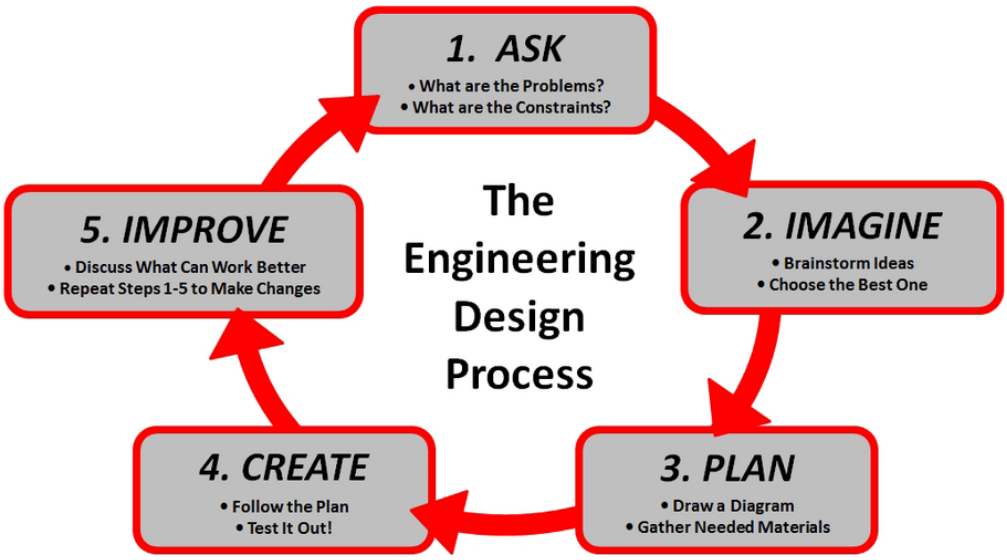
Problematic context

The students of the Icesi University of the programs of anthropology, political science, law, and others, are in trouble since in several of their career work they are required to analyze a lot of information from databases, due to the complexity of these data and a large amount of these, it is tedious to perform an overall analysis of these and to represent them statistically in a graph.

For this reason, the students have decided to hire systems engineering students to develop an application, which allows the analysis of a database with a filter system to have more specific data and make it more readable; in addition to providing the exact location of this information, thus giving a more global analysis of these and implementing graphs that allow the comparison of specific data.

Solution Development

We will follow these steps shown in the flowchart below to arrive at the solution development:



PHASE 1: PROBLEM IDENTIFICATION

Problem definition

A group of students at the Icesi University requires a program capable of reading databases to filter the information from them, to perform a complete analysis, and display their data in a graphical representation of data and a global map.

Identification of needs and symptoms

- The program needs to be able to read files with a large database.
- Create a report that allows displaying a list in a readable table in the interface.
- You need to filter the data in the table to view data determined based on specific filter criteria.
- The selected dataset is required to have georeferencing elements.
- Display the information on a map achieving the exact geo-localization of this information.
- Implement statistical graphs to compare data.

PHASE 2: GATHERING THE NECESSARY INFORMATION

Requirements for the solution of the problem

RF1. Read information from a file, the user can choose the desired file in a spreadsheet-like format to be read by the program, which will be analyzed in a dataset. It is possible to enter the application by reading the file, where the user selects the document.

RF2. Display the information in spreadsheet format, the information read from the database will be displayed in this same type of format within the interface, so that the user has better visualization of all the data.

RF3. Filter based on the fields of the dataset, showing a certain amount of related data. The user selects which field to filter to have a more detailed analysis of the information.

RF4. Filter by having an option to allow elements to appear and disappear on the map. This means that elements that are markers (symbols that appear on the interface map) will point to the exact location of the information.

RF5. It allows to make different types of graphs such as bar, pie and points, with the objective of comparing data, for better understanding of this information, these graphs are already predetermined in the application therefore these are made with strategic data for the database to be treated.

Constraints to the solution of the problem

- The program must be implemented in C# with Windows Forms using GMaps. where the selected dataset must have geo-referenced elements.

- The solution must have an interface with a table, statistical graphs, and configurable buttons.

Definitions

Treaty: A treaty is an agreement between two or more countries under which they assume a series of obligations. Thus, treaties signed between states fall within the framework of international law.

Agreement: An agreement is a decision taken between two or more persons, associations, or entities, because of a process of negotiation and deliberation on a specific matter. The word "agreement" has as synonyms and related terms: pact, convention, treaty, resolution, and convention, among others.

Bilateral: An international treaty is a written document between two or more countries that seeks to standardize norms related to international relations in order to grant protection, rights, obligations, coordination, among others, in different areas; they are called bilateral treaties when signed between two countries, while multilateral treaties are those signed between three or more.

Places of adoption: Place determined so that there is a treaty-neutral environment where you are given all the tools both professional and environmental to achieve the treaty.

State: A social community with a common political organization and its own territory and organs of government that is sovereign and politically independent of other communities.

International organization: An international organization or intergovernmental organization (IO) is defined as "any group or association extending beyond the boundaries of a particular State and adopting a permanent organizational structure".

Nature of the Treaty: Refers to the fact that the objective of the situation of this meeting is a treaty or an agreement.

Subscribed By Colombia: in this case it refers to the fact that, having found that they are treaties or agreements that were **signed** by Colombia for the world, this refers to the fact that a Colombian person with a specific position will be in charge of leading the deal or agreement.

In force: The treaty or agreement now is in execution or closed.

Map visualization: There is the GMap.NET tool that allows to visualize maps, add markers and polygons. The markers will be useful to visualize the countries that have signed a treaty.

PHASE 3: SEARCH FOR CREATIVE SOLUTIONS

For the generation of ideas, a sequential review of previously acquired concepts related to the needs of the problem described above was carried out. Based on the above, the possible solutions found are presented below:

Tools:

- GMapControl, DataGridView, Buttons, ComboBox, TexBox.

- Pointer (GMap), listView, Buttons, ProgressBar, TextBox.
- Pointer (GMap), listBox, Buttons, CheckedListBox, RichTextBox.
- GMapControl, MenuStrip, Buttons, CheckBox, TexBox.
- Specify an exact format of the file to be read, in this case .xls format.
- Allow any type of file to be read inside the program
- Use the latitude and longitude format where the user enters the exact number of each of these.
- Automatically place the latitude and longitude of each country based on the name only. This is done through inverse georeferencing.
- Use the DbConnection API to read the database in multiple formats, such as SQL or Acess.

PHASE 4: TRANSITION FROM BRAINSTORMING TO PRELIMINARY DESIGNS

In this part we have discarded the worst alternatives that do not provide an adequate solution to the requirements, such as: B and C.

- We can say that in option B, not with the best solution since some of its tools such as ProgressBar and Pointer (GMap) do not allow me good data analysis capabilities.
- We can say that in option C, it does not fulfill the capacity to classify since the checkedListBoxes is not so restrained with so much information to classify.

In this part we have highlighted the best alternatives that provide us with an adequate solution to the requirements, such as: A and D.

- We can say that in option A, it has very good tools, in order to correctly satisfy the requirements and the general objective of the application.
- We can say that in option D, it has very good tools, to correctly satisfy the requirements and the general objective of the application.

We decided to allow only the .xls format to prevent people from trying to put formats that the program cannot set in datasheet mode, such as an image, a video, a song, among others.

The location of the countries was decided to do it with inverse georeferencing since generally in a database of this type, the information given is the name of the country and/or city, not the latitude and longitude of these.

Idea number 5 was chosen because of the ease and efficiency of connecting a file and converting it directly to a prepared database.

PHASE 5: EVALUATION AND SELECTION OF THE BEST SOLUTION

- **Information display criteria:**

  a. Allow the data to have a better compression.

- **Criteria for data placement in a georeferencing tool:**

a. Allow the data to be clearly located on the map.

  b. Allow the ability to zoom in and out for better visualization of the data.

- **Charting criteria to allow comparison of data:**
  - Allows the ability to compress statistical graphs easily.

Selection of data structure implementation alternatives

	Criterion 1	Criterion 2	Criterion 3	Total points
Alternative A	5	5		
Alternative D			5	

Since alternative A obtains the highest score, alternative D is discarded.

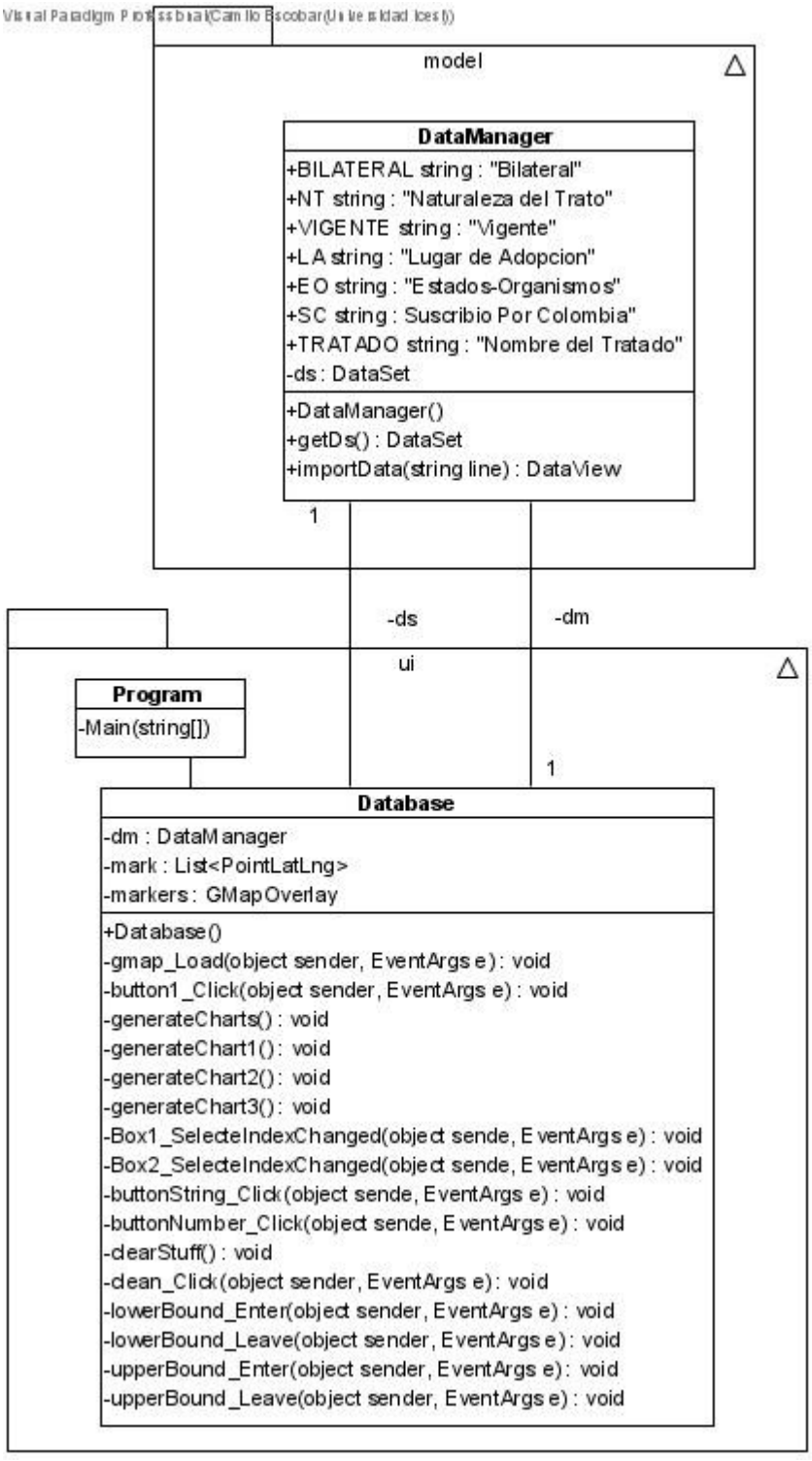
Reflective synthesis:

After the development of the engineering method, it was possible to reach the solution that was most adapted and efficient to the problem posed, also considering the resources that were available. The design of the interface was decided to be compact and simple, so that the student who uses it, has the facility to see everything without having too many windows or too many options that can become confusing. The brainstorming technique was used to generate ideas to solve the problem, which led to the selection of the idea of using the DbConnection API for file management, also the use of the GMaps tool facilitated the ability to solve the problem with the tool to locate on the map, the location of each country, just with the name.

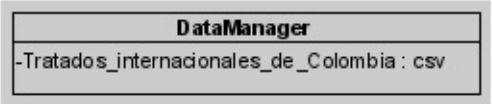
Finally, it is considered that the application proved to be a very efficient and intuitive way to solve the problem, since the user can easily understand the data and can easily manipulate it to perform the necessary studies.

PHASE 6: IMPLEMENTATION

Class diagram:



Object diagram:



Implementation:

https://github.com/FernandaRojas152/colombian-international-treaties

Webography

- Definition of "State" taken from: Paula Nicole Roldán, (2017), "State", Economipedia.com, (https://economipedia.com/definiciones/estado.html)

- Definition of "place of adoption" taken from: Polít. crim. vol.13 no.25 Santiago jul. 2018, (https://scielo.conicyt.cl/scielo.php?script=sci_arttext&pid=S0718-33992018000100444)

- Definition of "bilateral" taken from: 2015 Instituto Federal de Telecomunicaciones - Algunos Derechos Reservados, (http://www.ift.org.mx/espectro-radioelectrico/acuerdos-actas-y-otros-documentos-bilaterales-y-multilaterales)

- Definition of "treaty" taken from: David López Cabia.(2020). *Treaty*. Economipedia.com, (https://economipedia.com/definiciones/tratado.html)

- Definition of "agreement" taken from: David López Cabia.(2020). *Agreement*. Economipedia.com, (https://economipedia.com/definiciones/acuerdo.html)

- radioman. (Unknown). *greatmaps.* Github, (https://github.com/radioman/greatmaps)