Description of STATLAS Functionality

A description of the STATLAS functionality and the incorporation of each function in the overall architecture of the system

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Executive Summary

This document is the outcome of Task T3.1 (“Functional Analysis), of Work Package 3 of the STATLAS IST Project “System Design and Functionality Description”. It corresponds therefore to the Deliverable D3.1, as specified in the STATLAS work program. The document presents the progress made in the construction of the STATLAS application prototype as well as considerations into the future of the prototype.

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Chapter 1 - Introduction

1.1 Introduction

The Statistical Atlas of the European Union (STATLAS) will be based on atlas and mapping software that is currently being developed at the Institute of Cartography at ETH Zurich. This software is intended to overcome several limitations experienced in earlier projects and to provide a solution for a number of interactive map and atlas applications.

For most parts of the software, the software modules covering the functional characteristics of the system have been analysed and they will be developed to meet the needs of the project. Dependencies from commercial software vendors are reduced to a minimum.

Chapter 2 - Concepts

2.1 Functionality and Interactivity

The Statistical Atlas of the European Union (STATLAS) is based on the concept of producing maps "on demand". Within this concept, users are able to interactively select and combine base and thematic data to produce maps to suit their own needs. Two versions of STATLAS will be developed, a guided "non-expert" module and an "expert" module. The non-expert module will contain authored maps demonstrating accurate cartographic representation of the statistical data. The expert module will provide users with cartographic, GIS, and statistical tools to manipulate and visualize the data in their own way.

2.2 Map Quality

Map quality will be a measure of the graphic output of the maps as well as the accuracy of the data being mapped. At present, several different graphic libraries are being tested (see Chapter 5). Data accuracy pertains to the origin of the data, the NUTS level of data, and the completeness of the data at a given NUTS level. Ideally, the statistical data will refer to NUTS 3 level, but much of the data may only be available at the NUTS 2 level.

2.3 Map Viewer and Map Tool

STATLAS is designed to meet the demands of different types of users. It will for one part follow a traditional approach presenting pre-configured maps for a broad palette of themes and for the other part act as a tool for explorative visualizing the data of the atlas or an external source.

2.4 Cross Platform

STATLAS is being developed to run on a number of different platforms, including Windows, Mac OS, and Linux.

2.5 Extensibility

STATLAS in its current version will constitute the reference for future extensions of the project, both horizontally and vertically, by:

- Increasing the scale/detail of the information content
- Extending the geographical coverage of the data
- Developing more statistical analysis and GIS tools

2.6 Standards

The software will use existing standards whenever appropriate. Commonly used GIS and graphics formats will be supported in order to cooperate with existing software. XML will extensively be used for configuration, map and interface description.

Chapter 3 - System Design

3.1 Introduction

The map software consists of a collection of reusable and extensible components. There are four types of components involved: the atlas shell, the map core library, optional shared libraries, and plug-ins.

3.1.1 Atlas Shell

The atlas shell is the main program that provides the user interface and communicates with the map and atlas software. It can be any software that is able to call C/C++ methods (e. g. a native application, an authoring system, or a browser). Current prototype development is a Windows application (see below).

3.1.2 Core Libraries

The core library provides methods that are essential for the handling of maps in an interactive atlas. This library is responsible for data transfer, maintains an internal structure of the map data, visualizes map data and provides interactions with the maps. To do so, the core library uses services provided by optional shared libraries and plug-ins.

3.1.3 Optional Shared Libraries

This type of library provides methods that may optionally be used by an application such as an XML parser, a spreadsheet calculation, a database or an Internet access component. They are loaded when needed.

3.1.4 Plug-Ins

Plug-ins are typically used in order to modify or add functionality. Examples: reading and writing of additional data formats, use of an alternative projection methods, display of alternative map symbols or diagrams or the use of an alternative graphics library.

3.2 Data Model

Currently, a hierarchic data model is implemented. Points, lines, and areas form the basic elements, which can then be structured as hierarchical groups and layers. For GIS-like tasks an alternative topologic data model will be considered, probably using a variant of a winged-edge or lath-based approach.

Chapter 4 - Functionality

4.1 Navigation

STATLAS will utilize navigation techniques common to current cartographic and GIS applications. It will contain tools allowing the user to change the field-of-view by "zooming" in or out of select areas or "panning" across the surface of the map in order to change the area of interest. Also available will be functions allowing the user to change the scale of the map being viewed. Navigation between data topics and map layers will occur through index menus provided by the GUI. Using these menus, the user will be able to select both thematic and base map elements.

4.2 Queries and Search

All visible map objects can be queried to provide information about itself. Inversely, given one or more attributes, a user can search for map objects. Using a database system, more complex queries can be performed.

4.3 Cartographic Representation

Dynamic viewing and user interaction allow for the manipulation of the cartographic elements of the map, such as changing map layers and map symbolization. The selected level of expertise, i.e., “non-expert” or “expert”, will govern the amount of interaction with the user. Non-expert viewing will be limited to selection of suitable maps with default visualization parameters. Expert users will have the ability to change and manipulate cartographic elements, though; mechanisms to avoid common cartographic errors will be placed within the application.

4.4 Visualization

The core concept of the project is directly related to the application of innovative visualization techniques that enable dynamic viewing of geographical information. The core mapping process for statistical data is thematic mapping. STATLAS will utilize thematic mapping techniques, such as choropleth and proportional symbol mapping, to cartographically represent single variable, vicariate, and multivariate statistics. Overlay techniques will be employed to draw thematic information over top of base map elements, so as to obtain a coherent visualization of relevant information. Base map elements may include hydrologic networks, transportation networks, urban interfaces, land use, land cover, and 3D-terrain surface images. As well as map elements, STATLAS will incorporate additional statistical tools, such as charts, diagrams, and tables.

4.5 GIS/GeoStatistics

Current plans for STATLAS include providing GIS and geo-statistical functions to the application. Functions under consideration for inclusion in STATLAS include network analysis, geo-statistical functions, GIS functions

(e.g., selection, identify, buffer, and intersection), raster data processing (e.g., classifications), overlay of thematic information on perspective view, and animations.

Chapter 5 - Prototype

5.1 Current State

The intent of the STATLAS prototype is to test various technical aspects of multimedia atlas design. This prototype utilizes independent components to build an atlas from information taken directly from the C++ source code, as well as user input. The integration of the independent components forms the STATLAS application. This prototype serves three main purposes:

1.) Demonstrating the creation of a Graphical User Interface (GUI) built within a Windows environment.
2.) Demonstration of GISCO sample data.
3.) Testing of existing components, including libraries, plug-ins, data, and XML descriptions; and then testing the synergy between these components.

The prototype was developed in a Windows environment using Microsoft's Visual C++. Visual C++ was chosen as the development environment for two reasons; first, testing integration of existing libraries into the application could be done more efficiently; and second, Visual C++ provides resources and tools for constructing a GUI.

The data used in the prototype consists of sample GIS data for the countries of Austria, Germany and Switzerland. These data were received in Arc/Info export file format. The existing prototype supports the import of two GIS file formats: Arc/Info export files and ArcView Shapefiles. For the purposes of the prototype, ArcView shapefiles were imported. For the output of the sample data, three graphics libraries were tested: system graphics (graphic library native to the local machine), Libart graphics library, and AlphaMask Graphics Library (AGL). The system graphics are constructed using graphic-oriented Application Programming Interface (API) functions provided by Windows. Libart is an open-source graphics library that implements extended graphic functions, for example anti-aliasing, transparency, and bézier curves. These graphic functions enable higher quality cartographic representation. Being an open-source program in the early stages of development, Libart currently displays some difficulties in displaying polygonal data. AGL is a commercially distributed graphics library with the same advantages as Libart, that is, it implements anti-aliasing, transparency and bézier curves.

In constructing the GUI, several methods libraries provided the tools used the application. These libraries provided the functionality to import data types, draw the map, change scale, and export the map into various graphic file formats. The methods that allow the application to import the data and draw the map are coded directly into the source-code of the application. At this time, there are no interactive controls available to the user to either import new data or redraw the map. The change scale and export methods are integrated into the application with dialog boxes that allow the user to interact with the data.

5.2 Future Plans

In the near future, we plan on the continued use of Visual C++ to develop the prototype. In this environment, we will be able to implement new components in order to test their functionality within the application's GUI. It is the objective of this prototype to allow the user to interactively access all implemented methods through the use of dialog boxes, menu selections, and other elements of the GUI.

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