QUICKMAP - A COST EFFECTIVE, EMBEDDABLE CARTOGRAPHY SOFTWARE

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ABSTRACT:

QuickMap is an advanced cartographic software, easy-to-use yet powerful and extensive in functionality, embeddable out-of-box solution for image feature coding and map generation. It is a low cost interpretation tool that provides cartographic functionality to annotate images and generate maps with required scale and customizable layout (including North Symbol, title, image source, Map ID and Map category, corner lat – longs, scale bar). This software supports utilities to save the features in shapefile format with symbols and coordinate system information. Image with annotation & layout can be saved. This application is developed using MapObjects and VB on windows platform as an Active – X Control that can be embedded in any other application.

1. Introduction

Cartography is a science of representing, transforming and interpreting spatial information with the language of graphics to communicate to the user. With the advances in computer technology and the information management, cartography has taken new dimensions and gave impetus to digital mapping. The benefits brought with digital mapping not only include efficient representation of map elements but also effective storage, retrieval and analysis of data. It offers dynamic environment to view multiple representations of data and also helpful in exploratory analysis.

Whenever a satellite image is acquired with a specific requirement, it needs to be analyzed quickly. Analysis includes demarcation of areas of interest, labeling different features for reference etc. With the availability of satellite images in different resolution and with increasing use of the images in various applications, image interpretation is becoming a common and demanding work. Most of the GIS and image processing software like ArcGIS, Geomedia are either huge and expensive or simple map viewers. They provide tools required for this purpose at a very high cost. Moreover, when the similar work is to be done by more people, cost will be multiplied even though functional requirement may be met with less than 10% of the scope of the software. Hence, there is a need for cost effective tool. In this context QuickMap (Figure 1) is developed using MapObjects library, which is a low cost GIS functions library. This tool can work independently as well as it can be embedded in any other application.

A great deal of time, effort and money on cartographic process can be reduced with QuickMap. The software is developed as an Active-x control using MapObjects in VB environment on Windows platform. It can be embedded in any other application developed on windows platform.

Digital mapping using QuickMap facilitates creation, manipulation of geographic features, editing and map generation with extensible symbology in a user-friendly environment at very low deployment cost.

2. Requirements of a GIS tool

In general, there are many tools that can display images and allow users to add graphics over the images. These types of tools do not suffice the requirement in our context because user wants to create geographic features as part of interpretation. In other words, user needs to maintain a proper coordinate system, geometry of geographical features and more importantly necessary attributes are to be linked to each feature. This emphasis the need of a GIS tool to cater to the following tasks:

- All popular image formats are to be displayed.
- Cartographic tools to create different shapes
- Editing Tools.
- Measurement Tools.
- General Tools like pan, zoom.
- Hardcopy generation
- Export map composition as image
- Saving vectors.

The software bundled with the above mentioned functionality satisfies the requirements of an interpretation task. In the following section, we briefly mention the major modules of the software developed.

3. Design

The software should provide a display environment that allows images with vector overlay, editing tools to annotate images and functions to manipulate features with their properties. Hardcopy with a proper layout and scale is made part of output module. Export and save functions are provided to save the annotation along with general tools like zoom, pan.

3.1 Display

To allow user to display georeferenced images in any popular format, display panel is provided using MapObjects component.

3.2 Edit and manipulation modules

User can create and manipulate geographic features using edit

and manipulation tools. Editing module enables user to digitize points, lines, polygons, rectangles, ellipses and text labels.

Manipulation tools include copy, paste, delete, undo, resize, and reshape of the features. Feature properties such as color, size, font and symbol should be varied.

3.4 General

Facilities like Zoom-in, Zoom-out, Pan, Full-extent, Co-ordinate read-out and pixel read-out on the movement of mouse are provided. Keyboard Shortcuts for various menu options are provided.

3.5 Output

Once the interpretation is over, the user needs to take hardcopy output. For this required map elements like caption, source, map number, map category, north symbol etc., are provided. The print can be generated in required scale.

3.6 Saving and exporting

This environment allows saving geographic features in shapefile format, which is a standard GIS data export format for vector data. Map composition in the specified layout is exported as image.

4. Implementation

As discussed previously a low cost GIS library MapObejcts is selected to develop the software in VB environment.
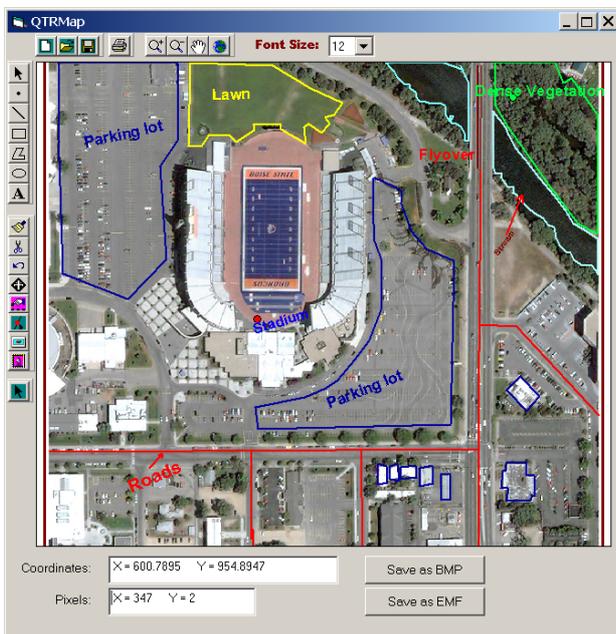
Figure: 1. QuickMap control with image and annotation
Image courtesy: www.digitalglobe.com/sample_imagery.shtml

Using QuickMap point, line, area features and text can be digitized. Area features include rectangle and ellipse shapes also. All these features can be drawn in different colors, sizes and styles.

Separate dynamic arrays are created for storing all the geometric features, text and for their respective symbols till the features are saved to disk. Every feature is associated with a

symbol, which has the properties style, size, color etc. One-to-one correspondence is established between dynamic arrays of features and their respective symbol arrays. As the features are being digitized, they will get added to these dynamic arrays along with their symbols.

Features attributes like style, size, and color can be modified independently. Editing tools viz., reshape, resize, copy, paste, delete etc are provided that can manipulate the features. Text orientation along a linear feature and at any angle is provided.

Geographic features and text can be saved in ESRI- shapefile format. Once a shapefile is displayed, new features can be added / deleted and the attributes of the features can be changed for the same shape file.

Standard tools viz., zoom-in, zoom-out, pan & full extent of the display, coordinate read-out, measurements like length of a line, area of a closed feature are provided using the MapObjects library where as angle w.r.t north functionality is an extension.

Projections are implemented on annotated features. During interpretation, features are transformed to Projected coordinate system to facilitate accurate length and area measurement.

Hardcopy is generated with layout components (ref Figure 2) with options like print to scale, fit to page; print to file as BMP or EMF. Layout is made editable and can be saved as shapefile for later use. Hardcopy layout can be saved as image file.

Print menu (Figure 3) allows the selection of printer from a list of available printers; different sizes of paper with landscape or portrait orientations at required scale or best-fit scale.

Facility to create and insert Insets of maps and images into layout is provided. Editing tools for insets such as resize, replace, remove, refresh, copy, on/off vectors are also facilitated.

Since this entire application is developed as Active -X Control, it can be directly placed into the user interface of any other application and can be easily integrated with common software packages.

5. Extended Functionality

Basic cartographic functionality provided by MapObjects is extended to a great extent to facilitate user with flexible drawing and symbolization.

5.1 Line feature

When the analyst is drawing a line feature at a higher zoom level, he may like to pan the map to continue the line to the new extent. To provide this functionality, the digitization process can be made at different levels, using the functions like Extendline, snapline, joinline.

Extend option allows the user to extend the line feature from any side whereas the Snap option allows the user to connect two lines. Snapping of a line is provided at the vertex level. The first vertex of the second line will be snapped to the nearest vertex of the previous line. The two lines are joined but still remain as separate entities. Sometimes there is a need to make two separate lines into a single line. For achieve this Joinline option can be used. It allows the user to join two separate lines to form a single line.

Along with above functions, splitline is also provided that splits a line into two segments at a desired location.

5.2 Text feature

Shapefile format does not cater to store label as annotation feature like in Arc/Info. To store labels as part of shapefile, label has to be associated with a geometric feature and label will be stored in one of the fields of the shapefile.

To enter the label a dialog box interface is provided. Label can be fitted along a line, splined or drawing at an angle are facilitated and as well as orientation in the required direction. Stored labels can be retrieved and displayed. Label font, size, color, characters in the string can be varied.

5.3 Editing at vertex level

It is useful for resizing and reshaping of geometric features. Select, move, insert and delete vertex functions are provided. This functionality is achieved through parts, item methods of MapObjects.

5.4 Arrow

Arrows are used as pointers to important features or to highlight certain locations on map. Two ways of drawing arrows are implemented. Any digitized line can be converted to an arrow by selecting auto-arrow option, which creates arrowhead at the end of the line.

Depending on the slope and length of the last part of the line, the two end points of the arrowhead are calculated and added as additional part to the line.

Second option is by selecting from the list of true–type font symbols.

5.5 Additional symbology

MapObjects provides limited styles that are insufficient for advanced interpretation. To facilitate the additional required symbols, many point, line, arrow and north symbols are implemented from true-type fonts. True-type font set of symbols each corresponding to an ASCII character is provided.

5.6 Shapefile editor

Facility is provided to edit the stored shapefiles. This allows editing of features and their attributes. The features can be created, modified, deleted. Properties of the features like style, size, color etc can be varied.

5.7 Saving the map annotation

The graphics including labels created during interpretation are stored in shapefile format. All geographic features along with label can be saved in shapefiles.

Additional fields are added to attribute table to store non-spatial information of the geographic features. Projection parameters are also stored.

Rectangle and ellipse shapes are also treated as polygons and stored in the same shapefile. All geographic features are stored in geographic coordinate system.

5.8 Hardcopy Generation of Map

Hardcopy is generated at required scale with proper layout (ref Figure 2).

Tools are provided to place the elements like north symbol, scale bar, scale number, source information, corner co-ordinates, page layout, Caption, Category, North symbol, Scale bar, and Corner Lat-longs. Display of lat-longs can be toggled for the hardcopy. User can modify the layout before it is submitting for print.

The total extent required for the layout is calculated by adding space required for the layout elements to the selected image extent. Size of extent is calculated by converting pixels required to the map units. A polygon is drawn around the selected image extent to place the layout elements. North symbol is drawn as a point symbol, scale bar as polygons with alternate black and white patches and others as text.

All layout elements are stored as features that represent customized layout that can be readily imported, edited and used for print.

Figure 2. Print Layout

Print dialog box (Figure 3) allows selecting a printer from the list of available printers, paper sizes with landscape or portrait orientation. Scale to which image to be printed (optional).

Scale can be obtained by getting the ratio of the map size to the page size (printer paper size). Using conversion factor, map size is converted from map units to page units. To set the user defined scale for selected paper size, the calculation is done vice versa and the map extent is set correspondingly.
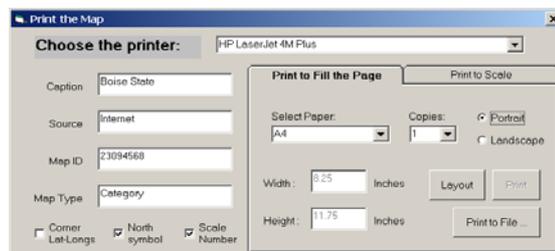
Figure 3. Print Dialog Box

If scale is not selected, it prints at the best possible scale. Input for caption, source, map id, map category and number of copies for print are provided. Auto resizing of the layout components based on the paper size for print is facilitated.

5.9 Map inset

Map Insets are used to highlight an area of interest from any map/image. They are used to display a blow-up region of interest and can be placed anywhere on the print layout.

Whenever a map inset has to be placed, a new instance of map component is created, the selected extent is set and the layers of main map are added. Display of annotation features for each inset can be toggled.

5.10 Coordinate read out

Coordinate readout is facilitated for analyst to know the location of annotating.

5.11 Export map composition

Map in the Normal view or Layout view at required scale can be saved as BMP or EMF. This enables to take hardcopies at a later stage and avoids making the map composition again.

5.13 Coordinate system

All popular projected coordinate systems are supported for opening geo-referenced images. The features in the shapefiles are transformed appropriately. On-the-fly transformation from geographic coordinate system to projected coordinate system and vice versa is done for shapefiles during the interpretation and saving.

5.14 Context menu

To increase the ease of usage, popup menus and keyboard shortcuts are provided for various functions on selected features and context.

Keyboard shortcuts are provided to increase and decrease the font size and size of the features.

6. Interaction with Parent Application

When the QuickMap software is embedded into other application, that application becomes parent and quickmap becomes child. In this context, methods are provided to access functionality from the parent application and decrease much of the user interaction. Some of the methods include OpenAnnotation, SaveAnnotation, GetImageSource, SetImageSource, PrintMap, PrintSilent, SaveImageBMP, SetCornerLatLongs, etc.

7. Design Advantages

This type of design has advantages like

- The functionality is available through interfaces, which allows modifying or enhancing the source code for their future requirements without disturbing the parent application.
- Integration is very easy, as QuickMap is based on COM model.
- Low cost deployment.
- Software distribution & installation is easy.

For doing all this, we don't need high-level software. It can be met by extending low-level software.

8. Development Environment

Entire software is developed using

- Map Objects library from ESRI
- Visual Programming Environment
- Windows platform

9. Conclusion

QuickMap is an advanced mapping component developed for Image annotation and map generation. It facilitates for storing attributes along with features in shapefile.

Using QuickMap one can overlay existing vector data on newly acquired imagery, create new features and make maps either in hardcopy or softcopy form.

The software accepts all popular image file formats as well as standard GIS vector formats for overlay.

It provides cartographic tools for digitization and manipulation of features such as points, lines, polygons and text. Rich symbology is facilitated for all feature types by extending the symbols sets. All geographic features are stored in standard GIS vector format. Functionality is provided flexible map composition. Multiple shapefiles can be opened and edited at any time during the cartography process. The annotated map can be exported to raster image output for future reference.

The map can be represented at different scales. Hardcopy and softcopy map generation with predefined/customizable layout, in user defined or optimum scale for all printer supported paper sizes in both portrait and landscape orientation is facilitated. Map layout can also be saved as raster image output.

The digital environment allows for timely & cost effective modifications to map design and independent storage of images and annotation. Raster and vector data can be combined to form composite map at a whim.

It is a low cost cartography tool with extensive functionality and our design makes software usable as independent or embeddable solution.