

The Development of “BAU GIS” Web/Program using Open Source MapWindow

B. Sadoun*, O. Al-Bayari, J. Al-Azizi and Samih B. Al Rawashdeh

*Department of Surveying and Geomatics Engineering
AL-Balqa' Applied University, Al-Salt, Jordan*

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Abstract: “BAU GIS” is a Programmable Geographic Information System that supports manipulation, analysis, and viewing of geospatial data and associated attribute data in several standard GIS data formats. “BAU GIS” program is a standalone application, developed using Map Window Open Source GIS and visual basic 10.0. It has been designed to address the need for a GIS programming tool that could be used in engineering research and project software, without requiring end users to purchase a complete GIS system, or become GIS experts. It is a GIS modeling system, and a GIS application programming interface (API) all in a convenient redistributable package. The BAU GIS application is free, extensible GIS that can be used as an open-source alternative to desktop GIS, in order to distribute data to others and develop and distribute custom spatial data analysis tools.

1 INTRODUCTION

Due to the advancement in the computing technology and the rising need for GIS applications (www.esri.com; wiki/ArcInfo; wiki/Google_Earth), more and more scientists are developing free of charge possibilities to those who cannot afford to buy commercial software. The main purpose is to serve the groups who are working in Meta Data management and who publish their works on the World Wide Web for all users.

MapWindow: This is a mapping tool, a GIS modeling system, and a GIS application programming interface (API), which was developed at Utah State University by Daniel P. Ames and a team of students (Appleman, 1998). It was developed to address the need for a GIS programming tool for research and projects, without the need to purchase GIS system, or become GIS experts. It is used to distribute data and to develop custom spatial data analysis tools (www.mapwindow.org; MapWinGIS, 194pp). Developers can write Plug-ins to add additional functionality (models, special viewers, and hot-link. Handlers, and data editors can pass these to users. It includes standard GIS data visualization features as

well as database functions such as attribute table editing, shape file editing and data converters. Dozens of Standard GIS formats are supported, including Shape files, GeoTIFF, ESRI format, ASCII and binary grids (GIS Fundamentals; FOSS4G). It includes a complete ActiveX component to instantly add GIS capabilities to the user's existing software product (MapWinGIS, 194pp; FOSS4G). Additional geo-processing components are available for .NET-compatible Languages. Components of MapWindow are: (1) MapWinGIS: This is an ActiveX control, which may be placed into any project in any programming language that supports ActiveX. This is the main map component - if the user wanted to write a program that displayed shape data, for example, the user could use this control for the display portion of the user's program. (2) MapWin Interfaces: Also called the "Plug-in Interface". It is a dll file, which will allow the user to write the user's own plug-ins to the main application. This may be done from any programming Language, which supports the creation and use of Microsoft .NET 2.0 Dynamic Link Libraries (dlls). (3) MapWinGeoProc: This is a .NET library of geoprocessing functions, including tools for managing projections, clipping and buffering.

Setting up the Development Environment: Using Microsoft Visual Basic 2010 Express Edition, the Visual Studio development environment main window is presented, to select Windows Form Application and to give a name (BAU GIS) to the web site. Then the process will continue to the tool box and all Windows Forms collapsible menu then to Map Control.

2 BAU GIS DEVELOPMENT

A. The first form user will see is the “frmIntro” which is the introduction frame in BAU GIS (Fig. 1). This form “frmIntro” includes: Images from BAU and two labels in the bottom of the form.



Figure 1: "frmIntro" form in BAU OSGIS Web Site.

B. The second frame is the “frmMain” form which is the main frame in BAU GIS (Fig. 2). All other frames are connected to “frmMain.” These are used to apply some commands and display results. The “frmMain” of the BAU OSGIS form consists of the following parts:

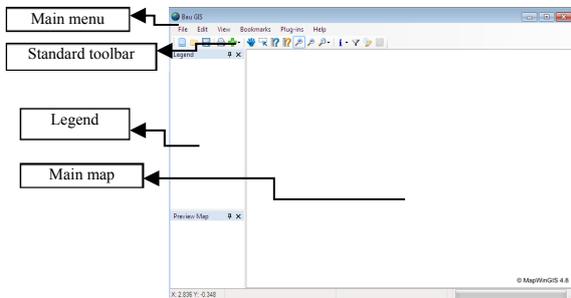


Figure 2: The “frmMain” in BAU OSGIS Web Site.

- Main menu: Consists of five titles to give a specific command to work (Fig. 3).

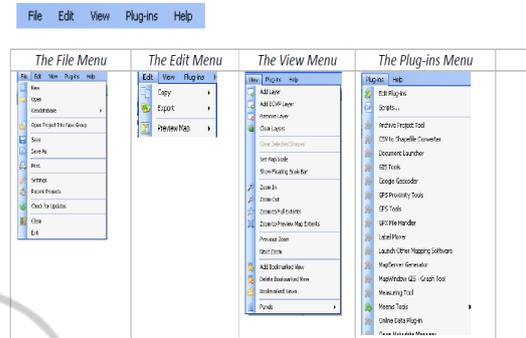


Figure 3: Main menus.

- Standard Toolbar: It consists of (14) icons; each gives a specific task to be worked in BAU OSGIS (Fig. 4).

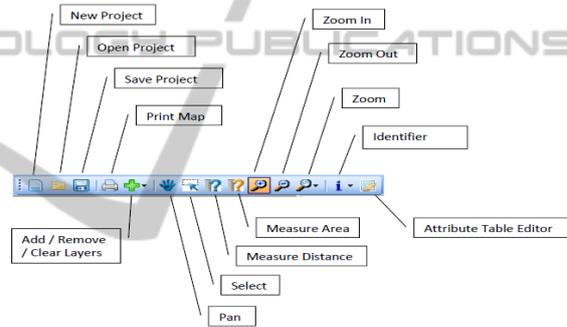


Figure 4: Standard toolbar.

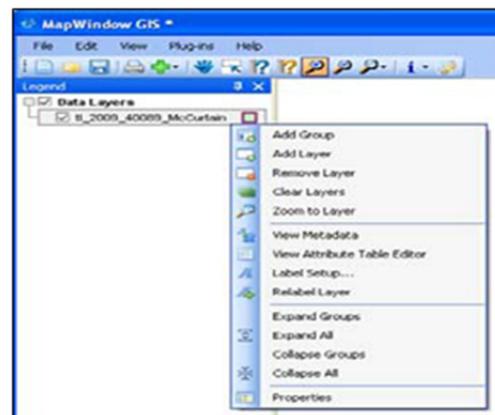


Figure 5: Legend used.

- Main Map: This is the utmost important part as most of the results will be displayed in this object. On main map you can do several functions and set

general display properties (display Map layer, tracking layer etc.).

- **Legend:** This is needed in order to clarify the symbols used to represent features on the map. Legend consists of examples of the symbols on the map with labels containing explanatory text. When you use a single symbol for the features in a layer, the layer is labeled with the layer name in the legend. User can open attribute for the layer or show properties, etc. (Fig. 5).

C. Many other forms like Error dialog, form about dialog, form plug-in, form choose projection, form project setting and others which are related to form main (Fig.6).

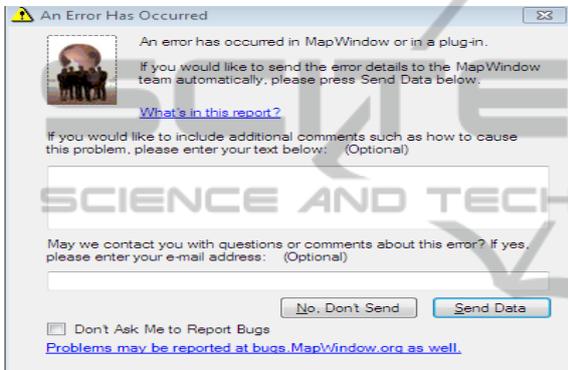


Figure 6: Other forms related to main fram.

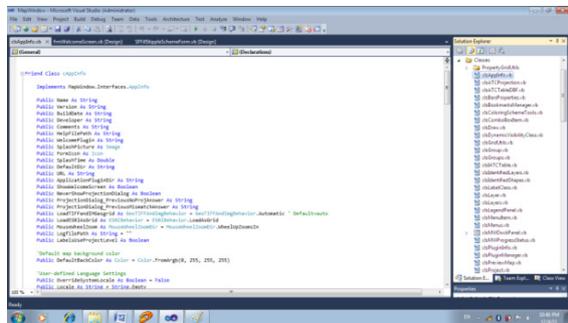


Figure 7: Classes for forms.

3 WRITING THE CODE

Classes: we wrote nearly 100 classes to use for all forms that are related in main form such as class: application, projection, draw, menu, layer, identified layer etc. (Fig. 7).

Codes: Some codes are meant for class application and description such as the code for measuring the area of a polygon. Other codes are written for drawing line, point, polygon with respect to the

shape file that you select from legend to start editing, etc.

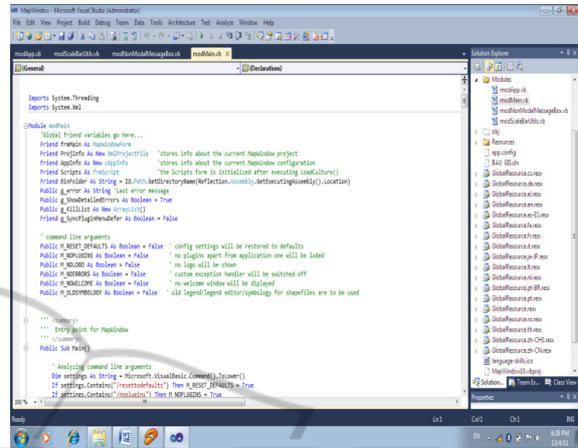


Figure 8: Modules considered.

Module: We wrote 20 modules to use for all forms that are related to main form such as module main, module application, among others; see Fig.8.

Running BAU GIS: When the "frm intro" appears, it starts to load other forms that are related to form main such as forms of plug in, etc. (Fig.1). After loading the main form, the form of the welcome screen will appear. Only the standard toolbars will appear in the main form (new, open, save, print, add data, pan, select, measure area, measure distance, zoom in, zoom out, zoom, identify, and query. If you want to show other toolbars related to main form you should press plug-ins from the main menu and choose what you need to work with.

4 IMPORTANT CONTENTS OF THE PLUG-IN MENU

- **GIS Tool:** it is the function that includes the processes that are needed to build a GIS such as: assigning projection to grid or image or raster, Georeferencing an image or grid, generating a contour shape file and other processes (Fig.9).

-**GPS Tool:** This includes processes that should be applied when the GPS instrument is connected into a computer in order to process data, start logging track, draw GPS location on map, and display GPS information, see Fig.10.

-**Image to Map Tools:** This tool used to convert image to map registration by using least square method and to rectify image by using another original rectified image (Fig.11).

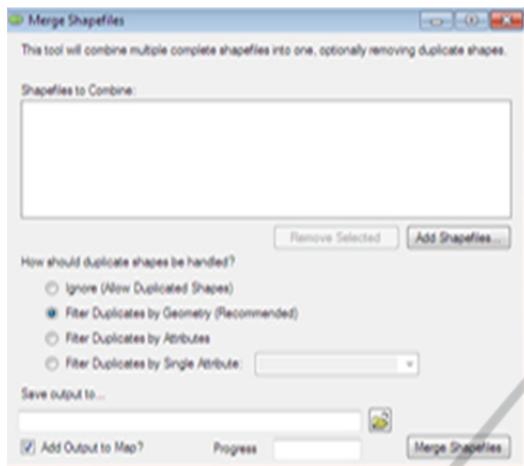


Figure 9: Merge shape files.

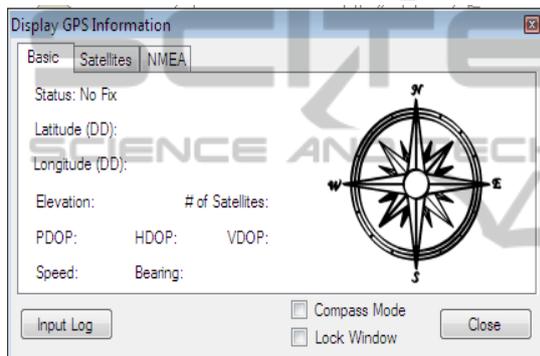


Figure 10: Display GPS information.

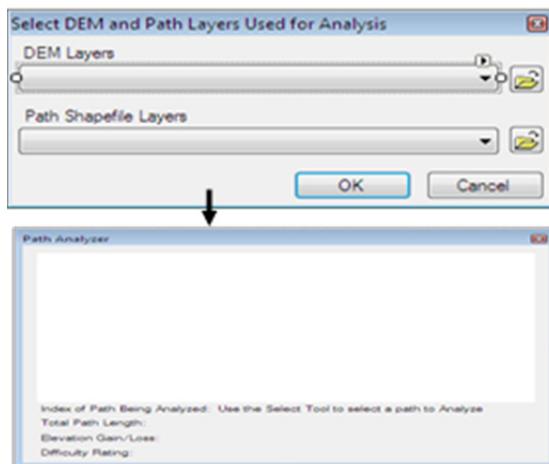


Figure 11: Image registration.

-Path Analyzer: This is designed to draw the path of the selected feature in shape file by determining the Digital Elevation Model (DEM) of the rectifying image and drawing this path as a profile to make other processes on shape file (Fig.12). The plug-in menu is very important.

Measuring Tool: These include function for measuring distance, and area for the selected features in the shape file.

-Shape File Editor: It is used to create shape file and start editing the shape file. It includes other processes that are related to shape file such as snapping, edit vertices, and merge of features.

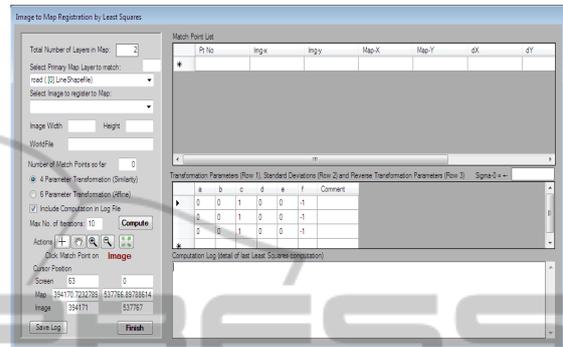


Figure 12: Path analyzer.

-Map Window Graph Tools: This is to allow drawing graphs using one field in the attribute field of the shape files (Fig.13).

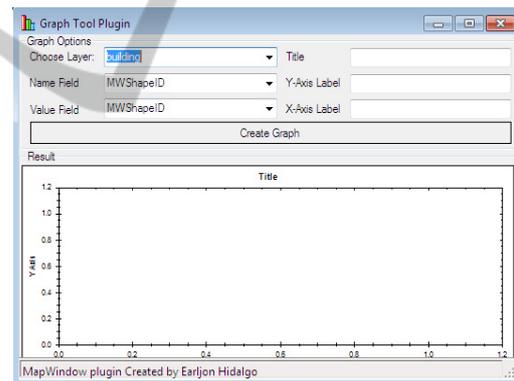


Figure 13: Graph tools.

The Reason for designing and developing this program is to fulfill the need of mainly our students in their GIS projects. Moreover, we posted the material on the web for all other users.

In order to improve our OSGIS, we have the following suggestions for future work.

- Download Mapwindow open source program.
- Create a new VB.Net Class Library project using Microsoft Visual Studio. Right-click on the class in Solution Explorer and select "Properties", Select the References page and click the "Add" button at the bottom of that form, then select the Browse tab and navigate to the location of and select the MapWinGIS.ocx and MapWininterfaces.dll;

typically, found in C:\ProgramFiles\MapWindow\ as shown in Figure 14 below.

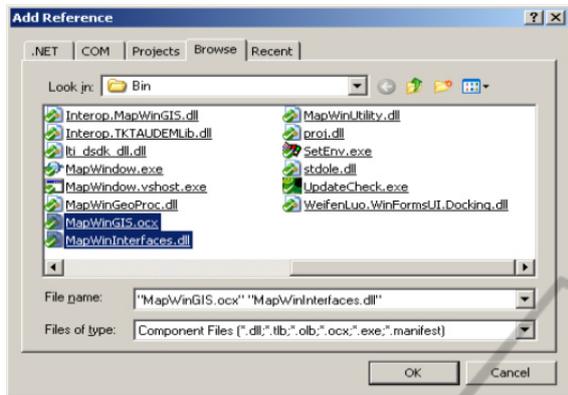


Figure 14: Adding reference from browse.

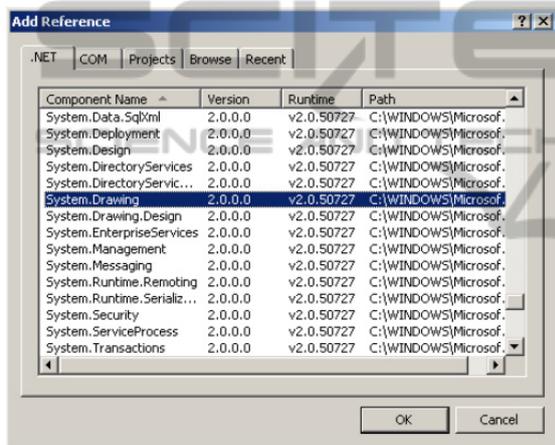


Figure 15: Adding reference from (.NET).

-In the compile settings, it is sometimes useful to set the build path to your MapWindow "Plug-in" sub-directory or a sub-directory within it, such as C:\ProgramFiles\MapWindow\Plugins\PathAnalyzer directory. This will save you the task of having to copy your plug-in DLL into the Plug-in directory for MapWindow in order to load when it runs. If using this, it is not strongly recommended not to forget that the path must be set for both Debug and Release properties.

-Back in your code, after the "Public Class..." line; insert the line Implements "MapWindow.Interfaces.IPlugin". Then hit enter on that interface and see how Visual Studio populates all of the interface properties and functions found in the IPlugin Interface.

5 CONCLUSIONS

To conclude, we presented the "BAU GIS" that is a Programmable Geographic Information System that supports manipulation, analysis, and viewing of geospatial data and associated attribute data in several standard GIS data formats. Basically, our system has the following features and capabilities:

- It is a standalone application, developed using Map Window Open Source GIS and visual basic 10.0.
- It uses an open Source Map Window soft.
- It has been designed to address the need for a GIS programming tool that could be used in engineering research and project software.
- It doesn't require users to purchase a complete GIS package.
- It doesn't require users to become GIS experts.
- It is a GIS modeling system, and a GIS application programming interface (API) all in one convenient redistributable package.

Finally, the BAU GIS application is free and extensible which can be used as: an Open-Source alternative to desktop GIS, in order to distribute data to others and to develop and distribute custom spatial data analysis tools. For example, a researcher or a company may want to deploy a tool that lets users build and interact with maps of GPS data overlaid on USGS quad maps. One approach is to build the tool as an extension to popular GIS software, and then require users to purchase that software to run the extension. Alternatively, the user/company could use BAU GIS as a platform and build a specialized application that does the needed function and then give it or sell it directly to end user with no need for third party software purchase.

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