Software for Landuse Management: Modelling with GIS

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Key words:

ABSTRACT

Land use management has been a very important issue in the planning and maintenance of environmental and economic development of a geographic area. Therefore, there is a need for proper management and preservation of naturally existing land use type for sustainable development.

In this project, a Visual Basic programme was written to serve as: an interface for the charting script in ArcView Avenue, the Visual Basic also aids in the generation of the coordinate of vertices of land use demarcation as released in the government gazette.

For the purpose of analytical management, an ArcView programme was customized to do operations like union, intersection, merging and combination. All these operations are very important for effective spatial management of land use data.

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INTRODUCTION

Land is the most important gift of nature without which no living thing can exist. Therefore, there is a need for sustainable and conservative management of this gift of nature.

In the recent time, there have been a lot of disasters in both urban and rural dwellings due to improper planning of land use. For example, most of the developing countries in sub-Saharan Africa are faced with a dilemma of limited essential physical resources, such as land, water, nutrients and energy and the lack of appropriate technologies necessary for increasing food production. Expanding human population and economic activities are placing ever-increasing pressures on land, creating competition and conflicts to access and to use this finite life-supporting resource.

Moreover, land use-planning aims at improved sustainable use and management of resources. In Nigeria for example, the basic land use management problems cannot be solved completely without considering these two basic approaches; cadastral - which deals with the property identification and positioning, cadastre – deals with law relating to ownership of the land. The departments of survey in most part of the country are still stock to old or foreign land use management approach, which is not given chance to improved sustainable use and management of land resources.

It is therefore paramount that an improved approach is needed for the management of land-use spatial data and its attributes. A geographic information system (GIS) approach is a highly favoured approach to the effective management of land use and land resources. With GIS techniques tailored in a way to suite a particular geographic settlement, activities like agriculture, commerce, sport, administration could be combined with effective use of land.

In this project however, I have tried to look into the traditional land use management approach and have develop software for it. The software was created using two languages: visual basic (VB), ArcView Avenue.

In visual basic, the distances and bearings, which are the major data released by the government, were used to generate the coordinates of the vertices or corners of the land use. VB was not only used to generate coordinates alone, it was also used to create a user-friendly interface for the users and utilities for linking other functions.

The management aspect was done in ArcView GIS. Using the avenue, scripts were written to fully customize the Geographic Information System (GIS) for the management of the land use.

The basic operations the software performs are as follows:

1. Visual Basic Graphical Users Interface (GUI) for the generation of the coordinate of vertices of land use from land use data released by government in the gazette. This visual basic program will also stand as interface to a customized ArcView project for GIS management purposes.
2. A customise ArcView script for accepting and charting the land use coordinate generated in the Visual Basic program in (1) above. The customized ArcView script also serve as a means of charting the new land use on to the existing land use base map.
3. For the management purposes, the ArcView project was customized to perform the basic polygons' operations like: Union, Subtraction, Combine and Intersection.

All these aims are for the purpose of effective land use management. The design and the functions of the Visual Basic programs is discussed below:

THE PROGRAM IN VISUAL BASIC 6.0

The program in Visual Basic 6.0 consists of one basic operating form and three software-linking menus.

The aim of the Visual Basic program is to generate a user friendly Graphical Users Interface for the generation of coordinates for the vertices of land use data given in distances and bearings. The control point for the data must also be specified.

The other parts of the program consist of an exiting module, editor-linking module, help and ArcView-linking module. The ArcView linking module helps to link a customized ArcView project for the purpose of land use management.

THE DESIGN OF THE VB PROGRAM:

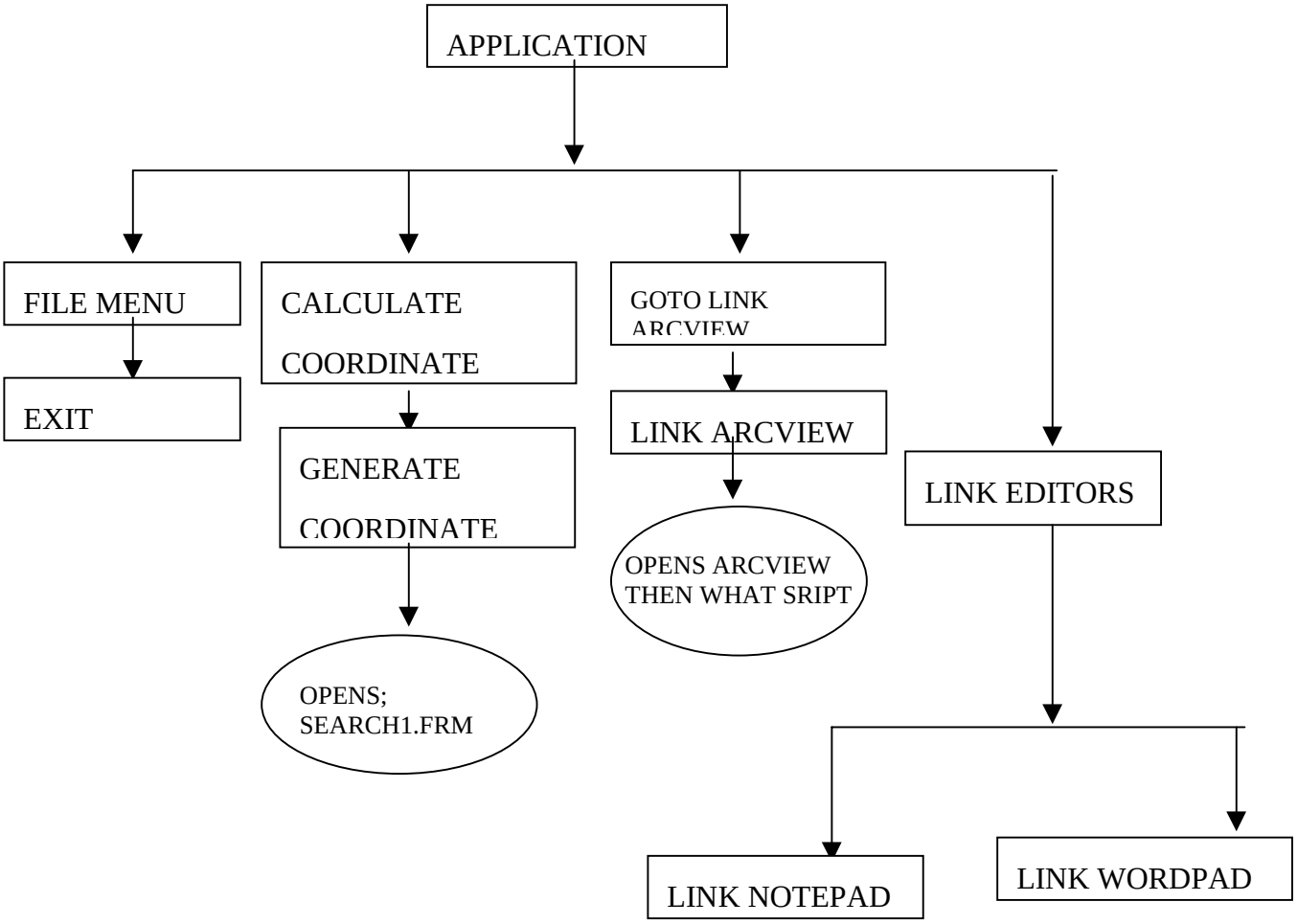

Fig. 1

GENERATION OF THE COORDINATE OF VERTICES OF LAND USE FROM THE BEARINGS AND DISTANCES AS RELEASED IN GOVERNMENT GAZETTE

For this purpose the *Calculate Coordinate* menu is used. This menu created with the menu editor is the second menu in the main menu. Under this menu is the *Generate Coordinate submenu*. The function of the *Generate Coordinate submenu* is to calculate the coordinate of the vertices of land use from the distances and bearings as released in the government gazette. Below is the sample format of the land Use data released in the government gazette. The station number and the coordinate of the control point are on the first row, while the subsequent rows consist of the station number, the distance and the bearing of the boundary of the land use.

0,540438.066,726430.314

1,68.82m, 20°58’

2,49.44m, 104 ° 43’

3,23.90m, 110 ° 04’

4,75.48m, 196 ° 30’

5,7.57m, 289 ° 19’

Considering the data specified in the section above, the drawing should be in the format below:

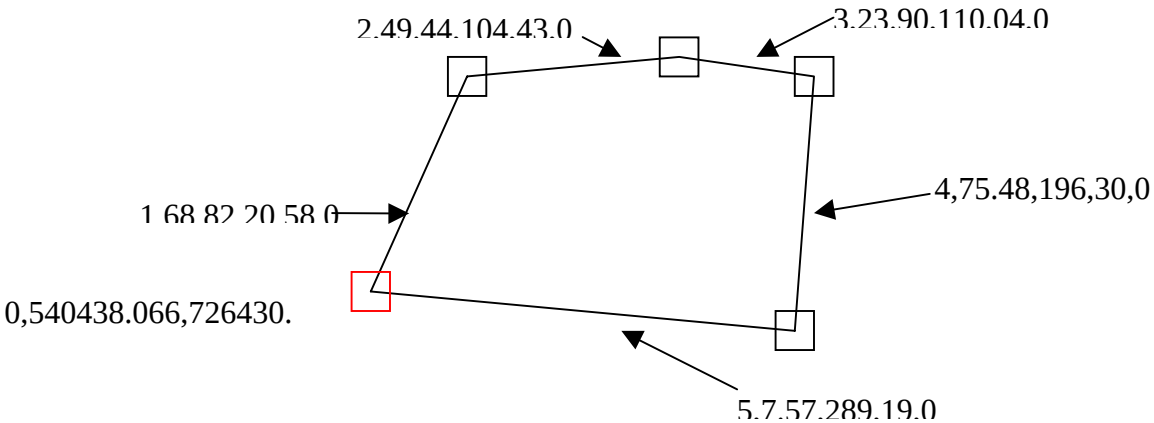

Fig. 2 This figure shows Sample Charting of Land use (the Chart is not drawn to scale)

The other module that is of great importance in this software is the ArcView-linking module. This is the main module, which link the charting module as well as the customized ArcView project. In the following discussions, which form the bases for my analysis, I will briefly discuss how the output file generated in the Visual Basic interface is used to plot the land use boundary into the ArcView.

CHARTING THE LAND USE DATA

For example, let us consider a land parcel at Ado village in Eti-Osa Local Government Area of Lagos State, Nigeria. Whose area is given as 37.448 Hectares and whose control is given as E = 565173.550, N = 718419.296 and in East of U.T.M. (Zone 31).

FROM	BEARING	LENGTH (m)	TO
PBS 23841	89° 11’	300.00	PBS 37867
PBS 37867	89 ° 11’	315.00	PBS 23842
PBS 23842	146 ° 31’	228.47	PBS 23843
PBS 23843	257 ° 09’	300.00	PBS 37868
PBS 37868	257 ° 09’	239.79	PBS 23844
PBS 23844	204 ° 08’	200.00	PBS 37869
PBS 37869	204 ° 08’	325.24	PBS 23845
PBS 23845	292 ° 28’	385.42	PBS 23846
PBS 23846	029 ° 20’	400.00	PBS 37870
PBS 37870	029 ° 20’	327.21	PBS 23841

Table 1 This table shows land use information in bearings and distances

Preparing the Data for Conversion

In order to chart the land use data, the distances and bearings as shown in table 1 are used to calculate the coordinate of the vertices of the land use. The table 1 above is converted into a format that will serve as an input for the Visual Basic program that will generate the coordinate of the vertices. The input file format is an ASCII file format created using either *Notepad* or W*ord pad.*

Using the Software to Generate the Coordinate Output File

To convert the data in bearing and distances to coordinate the *Generate Coordinate* Sub-menu under the *Calculate Coordinate* main menu is used. In the dialog that appears, the name of the input data file (i.e. ASCII file) can then be specified.

The result of the conversion of the data in **Table 1** is shown below:

PBS23841,565173.55,718419.296
PBS23841,565177.637977865,718719.268146102
PBS37867,565181.930354623,719034.238899509
PBS23842,564991.638421947,719159.829426056
PBS23843,564925.447079586,718867.222682804
PBS37868,564872.494005697,718633.137288202
PBS23844,564690.092163648,718551.103343905
PBS37869,564393.689170317,718417.798184422
PBS23845,564541.545991841,718062.321940027
PBS23846,564890.219370282,718258.349680835
PBS37870,565175.259857158,718418.602358945

Fig. 3 This figure shows the format of the output file

The result of this conversion is the station number and their coordinates.

CHARTING THE COORDINATE INTO THE CUSTOMIZED ARCVIEW PROJECT

For the purpose of charting the coordinate above (**fig. 3**) into customized ArcView project, the Link ArcView menu in the Software main menu is used. The customized ArcView project allows you to specify the name of the output file in figure 3 above for charting. The first dialog that appears required that the name of the output ASCII file be entered.
The output file can then be viewed on the existing Land use base map by clicking the add theme button on the main menu of the project.

The Add theme Icon allows the Analysis's file to be specified. Once OK is clicked, the land cover graphics is added to the View and can be view on the land use base map. The screen capture below shows the charted land use on the base map.

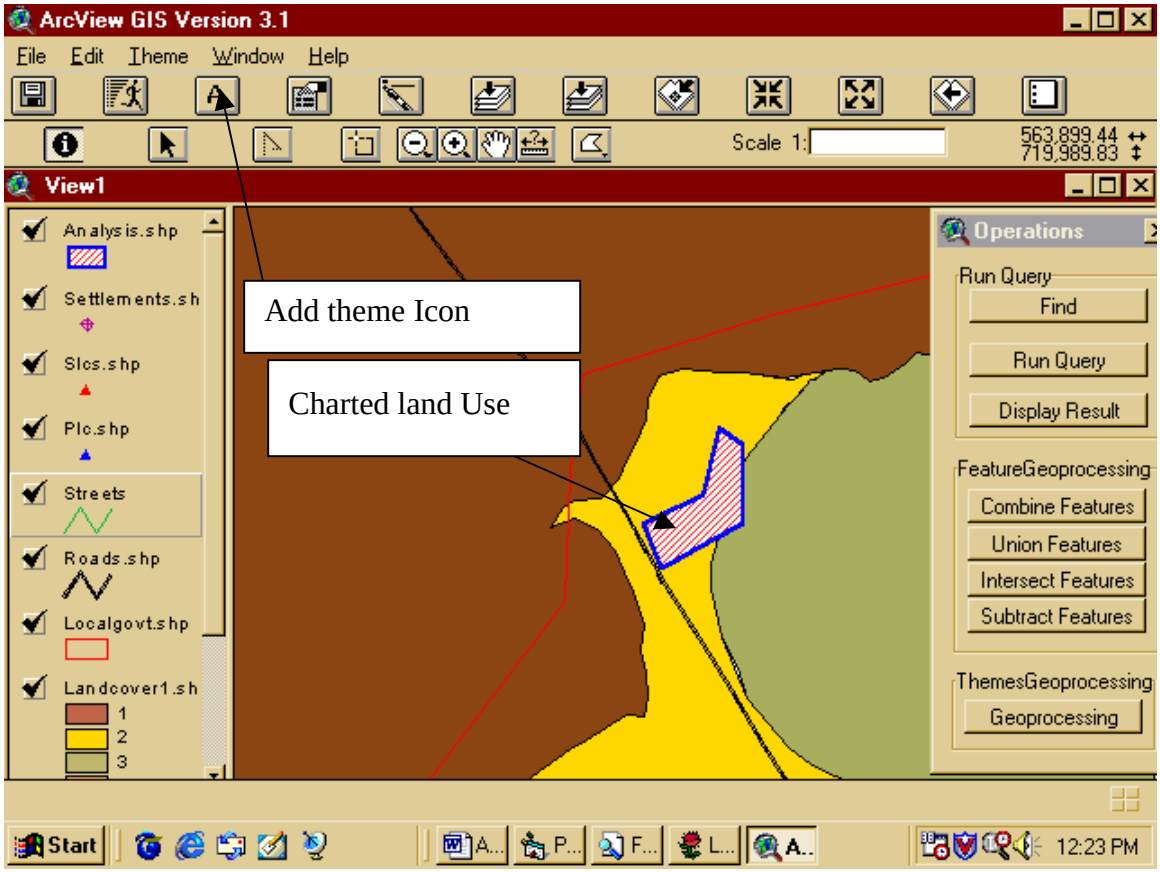

Fig. 5 This screen capture shows the Charted Land use

INTEGRATING THE NEW LAND USE INTO THE EXISTING LAND USE

The integration of the new land use into the existing land use is achieved by finding the union of the existing land use theme and the new land use theme. To do this, the Geoprocessing *command button* is clicked on the operations dialog on the right hand side of the view (see Fig 5.).

In the dialog that appears, *Union* option is chosen and in the subsequent dialogs, the name of the new theme (according to Fig. 5, new theme is *Analysis.shp*) and the existing land use theme is specified as the names of the two themes to unite. The result is saved as *union.shp* as shown in the screen capture below:

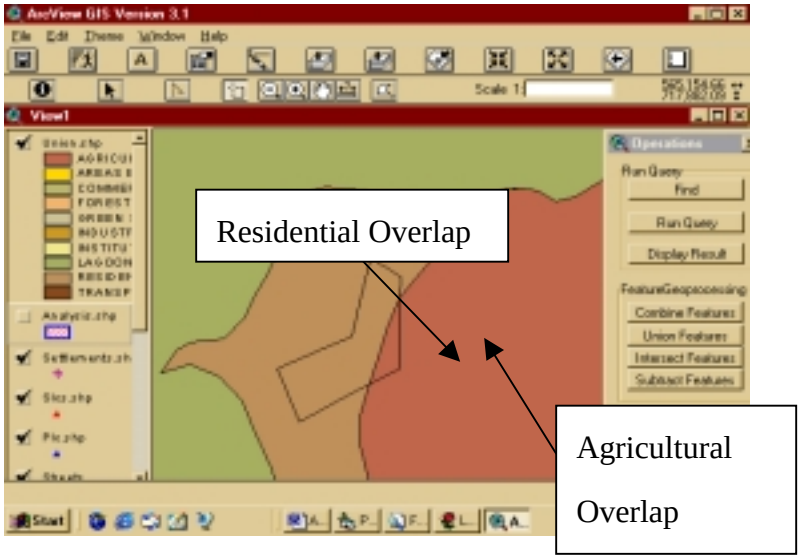

Fig. 7 This screen capture Shows the result of the union

In this result we can find the percentage of overlap of the new land use into the residential as well as into the agriculture land use. But before this, the area of the charted land use needs to be verified. To calculate the area of the new land use, select the *analysis theme*; click display result from the *operations Dialog*, select *create field* from the create *Edit menu* in the table document. Then create the Area field. Now, go to the *Field menu* select *Calculate.* In the dialog that appears type *[shape].Return.Area* this will give the value of the area into the *Area* field as shown in the screen capture below:

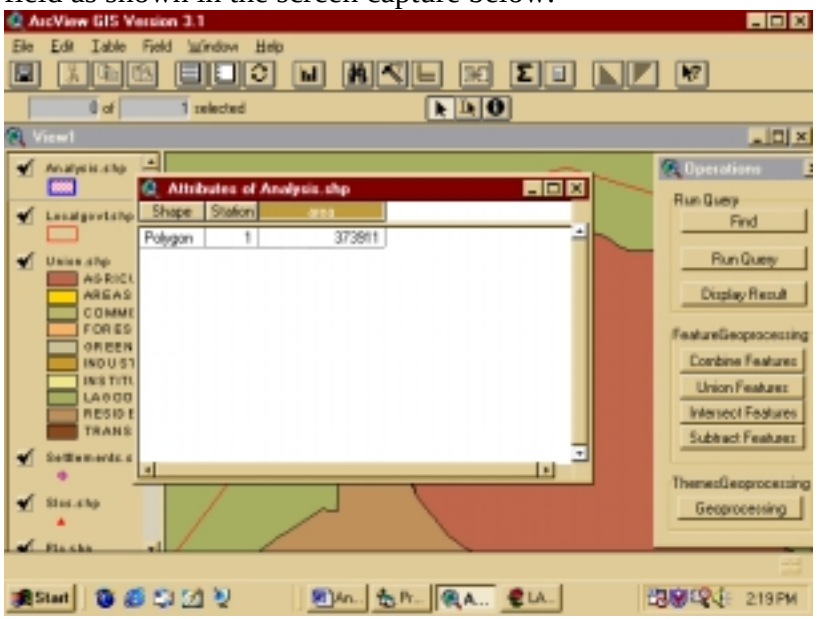

Fig. 8 This figure shows the area of Charted Land Use

The result of the area is 37.3911 Hectares. This can be compared with the Area calculated in the land use gazette.

The other analysis that could be performed include the Calculation of the area of encroachment into the residential and Agricultural land uses and consequently calculating the percentage of encroachment in both cases, Combination of features to form a single land use, Creation of doughnut polygons, Union of polygons, subtraction, intersection of polygons, merging. Also, operations on polygonal features of different themes can be performed for example: Polygons that *Are Completely Within* another polygon can be queried for, Polygons that *Completely Contain* another polygon can also be queried for, Polygons that *have their Centre In, Contain the Centre Of, Intersect, Are Within Distance Of* another polygons can be determined. Because land use analyses are polygon analysis, the polygons operations mentioned allows for effective management of land use.

CONCLUSION

It could be concluded that the software created has the capability of charting, managing land use not only in Nigeria but also in the other parts of the world. The system if adopted by government and the department in charge of land use administration, will enhance the management of their records and facilitate the use with modern data collection techniques like GPS and Satellite Imageries.

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BIOGRAPHICAL NOTES

O. R. Sodeinde is a graduate of Surveying and Geo-informatics, University of Lagos. He has participated in the development of Water Management Information System for Benin and Calabar cities in Nigeria. He has worked on boundary conflict resolution through the spatial analysis of social, commercial and cultural interaction of people leaving along boundary area. He is presently working on integration and scaling of time axis as a fourth dimension in GIS.