Corporative Applications Built with TeCOM, a TerraLib Microsoft Visual Component

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Abstract

TeCOM (TerraLib Components) is a software component compliant with Microsoft's COM (Common Object Model) to access and manipulate geographic data using TerraLib library. TeCOM implements methods and properties that create a productive development environment to create applications in visual Microsoft programming environment. Any language such as Visual Basic, Delphi, C++ Builder, C#, Visual Basic .NET and 4G languages like Centura or Genexus could build applications with TeCOM.

You can integrate a TerraLib Geographic Data Base (TGDB) with a legacy application in few minutes, attaching a Canvas with zooming, panning, selecting and highlighting features. Complex applications could be developed with the complete set of methods, properties and events. Many corporate applications where built with TeCOM for different areas, such as: Cartographic Applications, Urban Parcel Cadastral Map Systems, Urban Traffic Management Systems; Water Network Management Systems and Integration with Legacy Municipal Government Resource Planning Systems.

1. Introduction

TerraLib is LGPL geographic library, using GNU C++ that manages processes and manipulates spatial data as raster images and grids, vector maps and networks, and DTMs. It was conceived to create large databases in multi-user and distributed environment. TerraLib offers a large set of features to persist, retrieve and process geographic data stored in ANSI SQL RDBMS like PostgreSQL, PostGIS, MySQL, Firebird, Oracle or SQL Server. These characteristics made TerraLib suitable to create applications that manage geographic information for corporate use.

Nowadays, geographic applications became fundamental for planning and administration in municipalities. These applications are developed in majority for Microsoft programming suite, mainly Visual Basic and DELPHI. The use C++, the native programming language for TerraLib, would impose a severe constrain to disseminate TerraLib applications. The development of a component, using Microsoft Active X technology, looking for non GIS specialists, opens a real opportunity to introduce open source software, where mainly applications are proprietary;

TeCOM, licensed as GNU LGPL component, is developed using Microsoft Application Template Library (ATL), creating a component compatible with Microsoft Common Object Model

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(COM). Open TerraLib applications programming for most popular languages such as Visual Basic, Delphi, C++ Builder, C#, Visual Basic .NET and 4G languages like Centura or Genexus.

TeCOM was conceived for a non GIS specialist programmer, so it includes a set of high level methods, properties and events, very close to the application domain. Many corporate applications where built with TeCOM, such as: Cartographic Applications, Urban Parcel Cadastral Map Systems, Urban Traffic Management Systems; Water Network Management Systems and Integration with Legacy.

2. TECOM Component

TeCOM was build to easy integration with legacy systems and easy programming. Many players have integrated Municipal Government Resource Planning Systems (GRP) systems with TerraLib databases. A Visual Basic developer, without previous knowledge of geoprocessing, could create applications, calling high level customer oriented methods and properties. TeCOM breaks the dichotomy among TI applications and geoprocessing, reducing the learning time and generating results in short term. Actually the TeCOM has approximately 100.000 C++ code lines, with D'oxygen documentation and developers' documentation using Microsoft Complied HTML Help (CHM), including examples for each method, property and event.

TeCOM implements main TerraLib objects (entities) named View and Themes. A View is a user dependent visualization instance of geographic data. A View defines a particular cartographic projection to present data and defines which data will be presented. A Theme defines which restrictions will be applied to select objects from the original layer and which presentation style will be used. Basically, a View is a set of Themes; The components are organized in specialized sets, as follows:

TeCOMCanvas - Component for visualization and edition of vector data with user interaction;

TeCOMDatabase - Component to store and retrieve data from database to memory;

TeComExport - Component to export vector data to specific type file, such as Shape Files, DXF Files;

TeCOMImport - Component to import the vector file to TerraLib database;

TeCOMViewManager - Component to allow changing presentation and visualization.

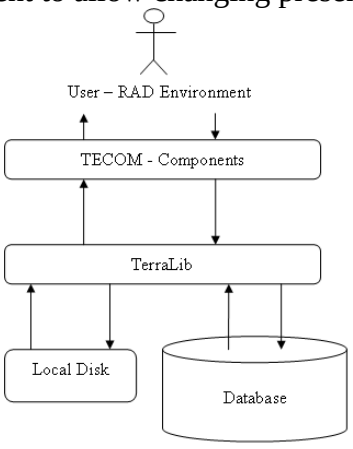

Figure 1. TECOM Components structure

The complete set of methods and properties can be reached at http://www.funcate.org.br/TerraLib/TeCOM

2.1 TeCOMCanvas

The TeComCanvas creates a visualization canvas using Microsoft graphical user interface (MFC). This component uses a connection to a TerraLib compatible geographic data base (TGDB) to visualize a View.

The component visualize raster and vector data allowing operations of zoom-in, zoom-out, zoom-area, panning, and maintain the extent visualization history to show previous and next plotting. A highlight and point features are provided too. The component is integrated in Microsoft visual programming environment, as shown in Figure 1.

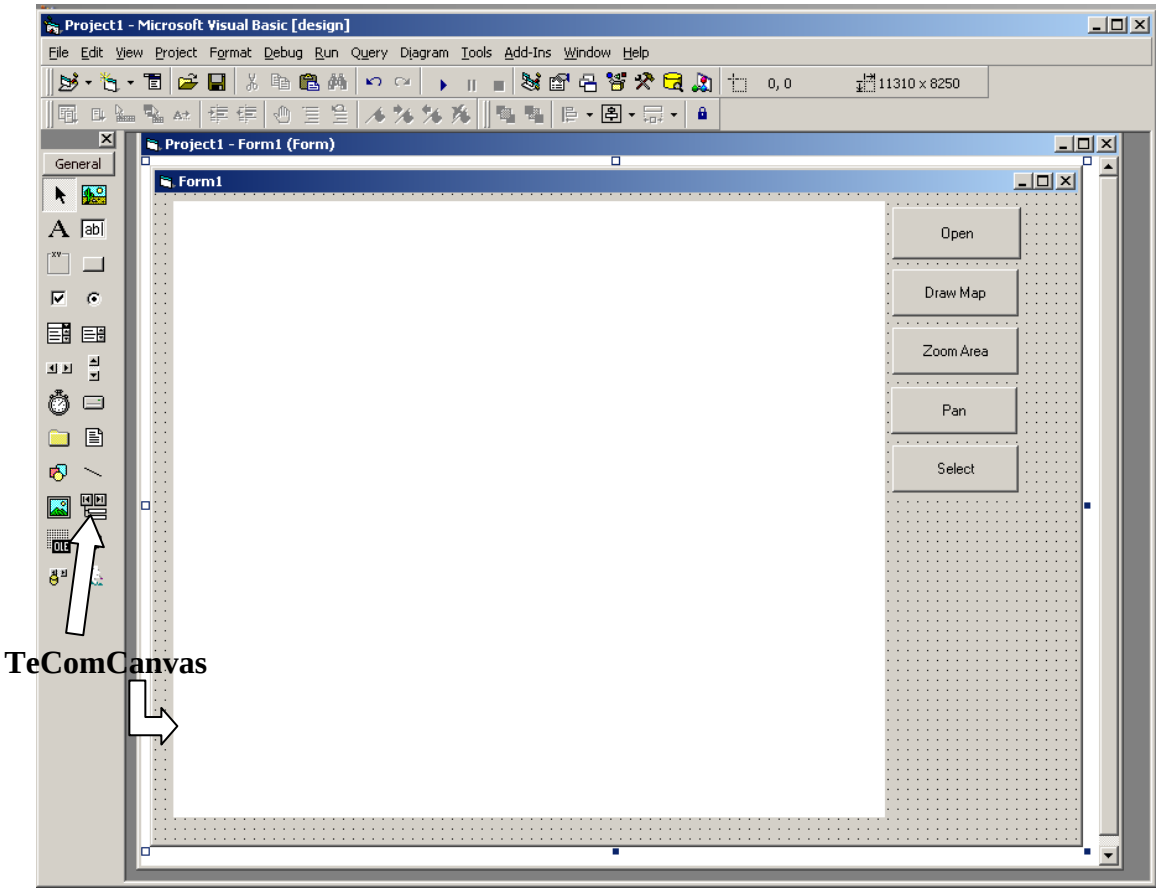

Figure 2. TeComCanvas in Visual Basic Environment

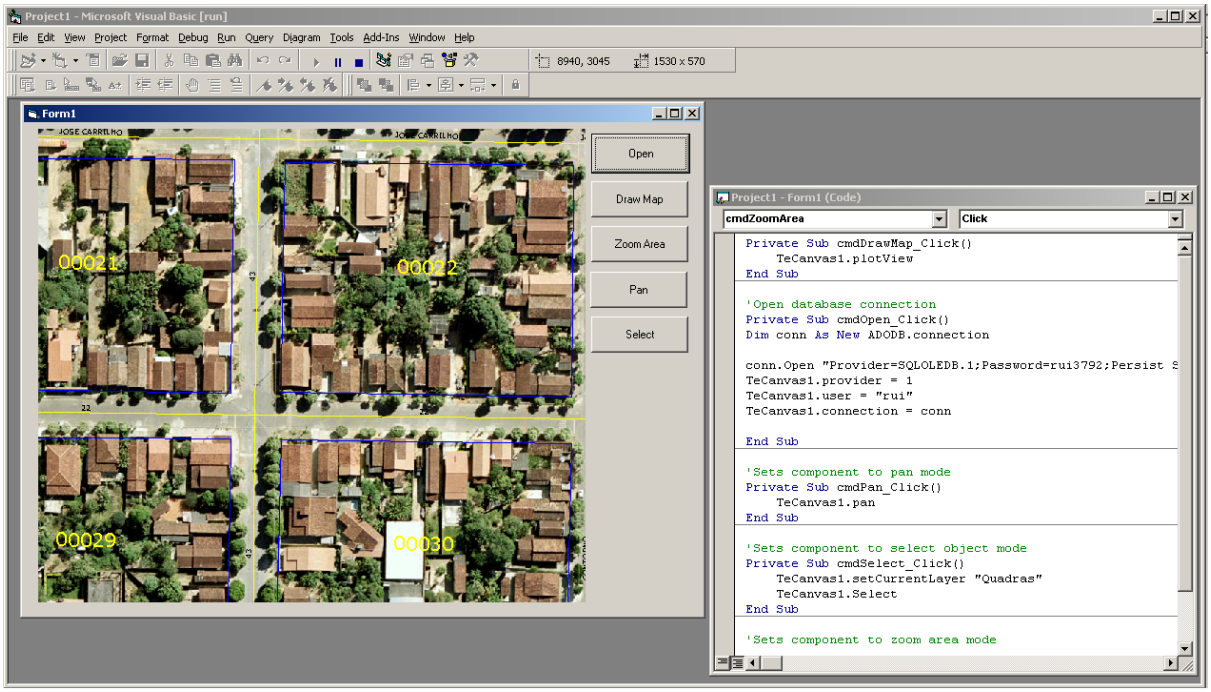

Figure 3. TeComCanvas viewing TerraLib database

Follow you see a sample code to create a basic application with TeComCanvas component.

```
'Open database connection
Private Sub cmdOpen_Click()
Dim conn As New ADODB.connection
conn.Open "Provider=SQLOLEDB.1;Password=xxx;Persist Security
        Info=True;User ID=userName;Initial Catalog=dbName;
        Data Source=geo-sqlserver"
TeCanvas1.provider = sqlServer
TeCanvas1.user = userName
TeCanvas1.connection = conn
End Sub

'Draw TerraLib database
Private Sub cmdDrawMap_Click()
        TeCanvas1.plotView
End Sub

'Sets component to zoom area mode
Private Sub cmdZoomArea_Click()
        TeCanvas1.zoomArea
End Sub

'Sets component to pan mode
Private Sub cmdPan_Click()
        TeCanvas1.pan
End Sub
```

```
'Sets component to select objects on “Blocks” layer
Private Sub cmdSelect_Click()
        TeCanvas1.setCurrentLayer "Blocks"        'selects  layer
        TeCanvas1.Select                          'sets select mode
End Sub

‘Get mouse click event
Private Sub onEndSelect()
        Msgbox TeCanvas1.getSelectObjectId(iIndex,TePOLYGONS)
End Sub
```

2.2 TeCOMViewManager

The component allows the programmer to create, modify or remove Views and Themes from database. Visualization styles, maximum and minimum visualization scales can be defined for each theme geometric type representation, permitting the user to define when and how to visualize geographical data.

View must be saved or removed from database to persist the operations.

Next the sample code to create a new View adds a theme form a layer and defines the color of line representations, using a previously connected database.

```
Private Sub createView_Click()
    TeViewManager1.provider = sqlServer
    TeViewManager1.UserName = userName
    TeViewManager1.connection = conn
    TeViewManager1.start
    If TeViewManager1.createView("New View") <> False Then
        If TeViewManager1.addTheme("River", "Theme_river") <> False Then
            If TeViewManager1.setLineColor("River", RGB(0, 0, 255)) <> False Then
                If TeViewManager1.Save <> False Then
                    MsgBox “ View and Theme created successfully"
                End If
            End If
        End If
    End If
End Sub
```

3.3 TeCOMDatabase

The component permits to save, retrieve, modify or remove geographic objects from database. Additionally, topological and set operations could be done using component’s methods.

Next sample code creates a TerraLib database structure from scratch.

```
Private Sub cmdCreateConceptualMode_Click()
        TeDatabase1.createConceptualMode true
End sub
```

3.4 TeComExport and TeCOMImport

These components permit to export and import vector data from a TerraLib database to local disk and vice-versa. Shape, Map Info, SPRING or DXF files are supported.

Next sample code shows how to export a layer to DXF file, using a connected data base.

```
Private Sub cmdExport_Click()
        TeExport1.provider = sqlServer
        TeExport1.connection = conn        ' connection to database
        If TeExport1.exportDXF("c:\rivers.dxf", "River", 1, "") = True Then
            MsgBox "Layer exported successfully"
        End If
End Sub
```

4. Cases

Many corporate applications where built with TeCOM, such as: Cartographic Applications, Urban Parcel Cadastral Map Systems, Urban Traffic Management Systems; Water Network Management Systems and Integration with Legacy Municipal Government Resource Planning Systems.

Urban Parcel Cadastral Map Systems developed are used by counties with population varying from fifty thousand to one million inhabitants, in Brazil. Multi-user network accesses and updates a geographic database with seamless high resolution image mosaics, with 10cm to 1m resolution, and vector maps, with compatible resolution for 1:1.000 to 1:2.000 scales, of blocks, parcels, buildings and street networks. Systems run on different RDBMS like Oracle, SQLServer, PostgreSQL, Firebird and Interbase. Geographic features are completely integrated with textual information creating a natural work environment for non-GIS specialists. The easy integration of GIS features with legacy applications liberates developer to concentrate in programming the user cases, checking for consistency and referential integrity. Systems created guarantee a continuous and decentralized maintenance, protecting the high initial investment needed to create an urban geographic and cadastral database from obsolescence.

Urban Traffic Management Systems, created on top of municipal geographic maps, manage all traffic signals and semaphores, accident events, traffic poles, urban transportation paths and maintenance of traffic infrastructure.

Water Network Management Systems manage water, sew and drainage networks. The system improves the creation of topological correct networks, with associated attribute data, in a natural and easy way. A created network could then be exported to EPANET, a worldwide used hydrology and water quality modeler application, developed by US Environment Agency, allowing flow simulation and leak detection. Additionally, technical services and customer information could be include the spatial location dimension allowing powerful planning and control.

The next pictures show some applications.

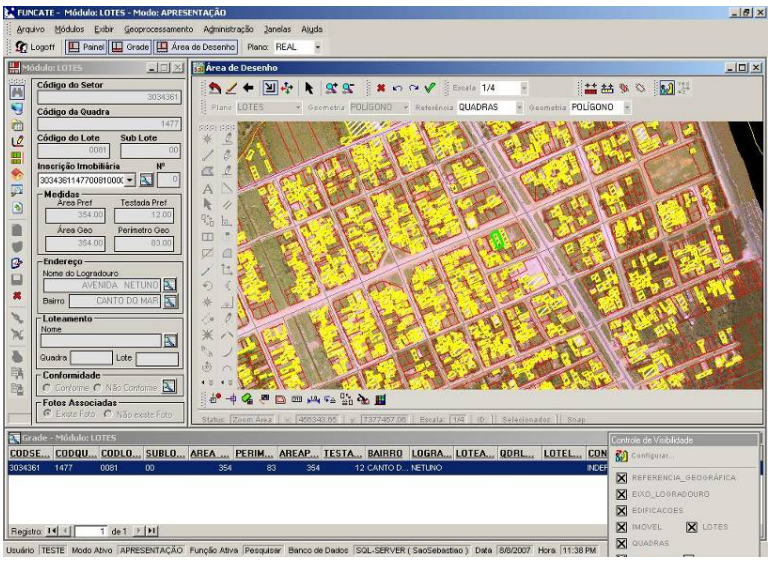

Figure 4. Urban Parcel Cadastral Map Systems

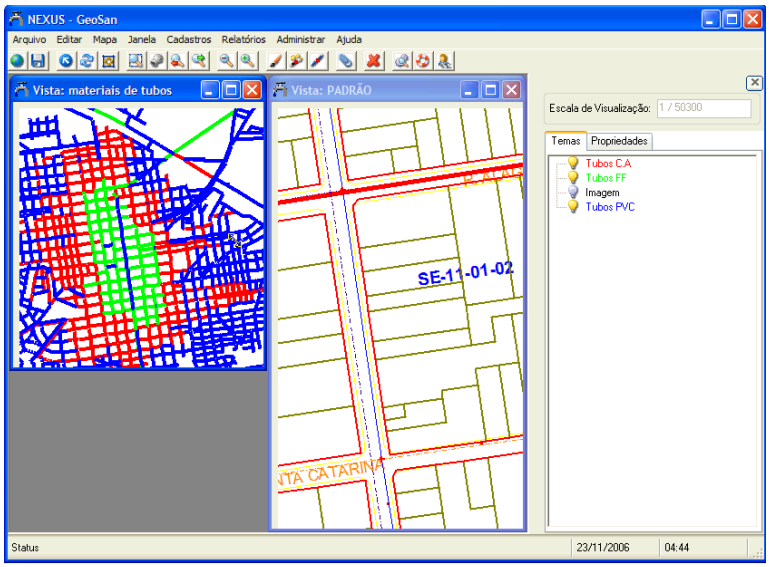

Figure 5. Water Network Management Systems

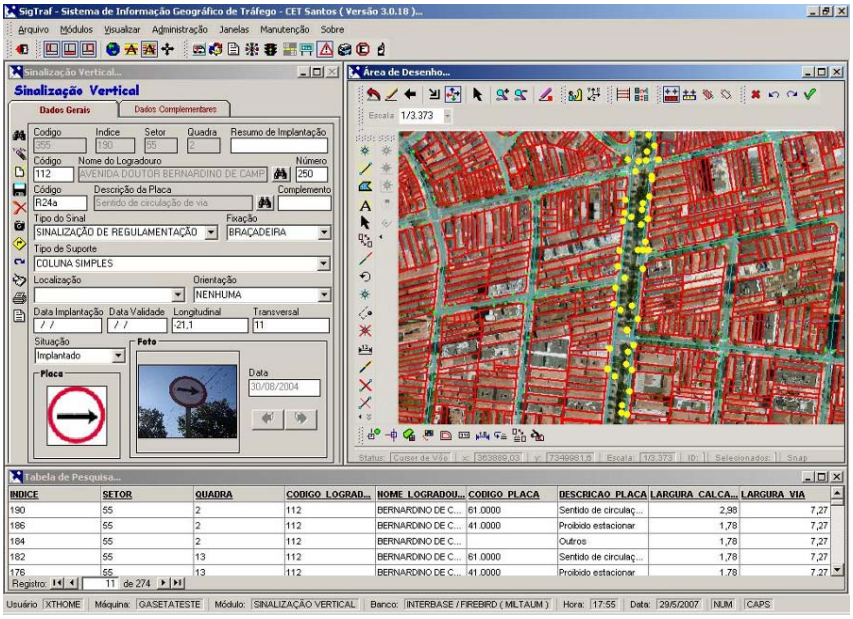

Figure 6. Urban Traffic Management Systems

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