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CENG463 GEOGRAPHICAL INFORMATION SYSTEMS

TERM PROJECT

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1. PURPOSE

There are many plugins available that can be used in the QGIS environment. These plugins provide convenience for developers using the QGIS environment. The project is a Python-based plugin that can be used in the QGIS. The purpose of this plugin is to load shapefiles containing only point geometry into the QGIS environment, view layers, delete duplicate layers (layers with the same file path), change the visibility of the selected layer via the plugin, and display the points in the selected layer through the plugin interface. In addition, by selecting two of these points, the distance between two points can be calculated. Two methods are presented to the user for the distance calculation. These are the Euclidean and Manhattan methods. In short, this plugin covers the combined state of some operations in the QGIS environment and the calculation of the distance between two points according to two different methods.

2. TOOLS AND TECHNIQUES

While developing the plugin, QGIS and Qt Designer environment, IDLE IDE and Python programming language were used. QGIS (Quantum GIS) is a geographic information system software that allows various operations on data. It supports the Python programming language. The Python environment in QGIS is PyQGIS. Since it is open-source software, it is constantly improving itself. It contains many plugins and the number of plugins is increasing day by day. In the project, a new plugin was created through the Plugin Builder plugin in the QGIS environment. The interface of this plugin was designed using Qt Designer. The one for Python is PyQt. After the plugin was created, the file with the .py extension was opened in the directory where it was created through the IDLE IDE. Appropriate codings have been made on this file. After the changes are made in the .py file of the project, a plugin is required to be able to work in the current version of the plugin in the QGIS environment or to display the errors of the current version. That's why the Plugin Reloader has been downloaded.

3. INTERFACE

The interface of the Python-based plugin created for QGIS was designed in the Qt Designer environment. The plugin consists of two Tabs within the TabWidget.

With the ToolButton in the first Tab, the file system is accessed and the user can select a file. The selected file path is printed to LineEdit. The file selected with Load opens in QGIS. ListView, the first table in Tab1, shows the layers currently open in QGIS. The Remove Duplicate Layers button allows the deletion of duplicate layers. The table located under this button is a ListWidget. It enables layer selection, along with the display of currently open layers. If the Change Visibility of Selected Layer button is clicked after a layer is clicked in the ListWidget, the visibility of the selected layer will change.

The first table in the Second Tab is a ListWidget and shows the currently open layers. After clicking on a layer from here, if the Show Points of Selected Layer button under it is clicked, the points in the selected layer are displayed. The place where these points are displayed is the TableWidget, which is the table under the Show Points of Selected Layer button. Points clicked in the TableWidget are displayed on the Selecting Points Label. There are methods for calculating the distance in the ComboBox. With the Calculate button, the calculation is made after selecting two points and the method. The calculation result is displayed on the Result Label. With Clear, the Selecting Points Label, the selected points, and the Result Label are cleared.

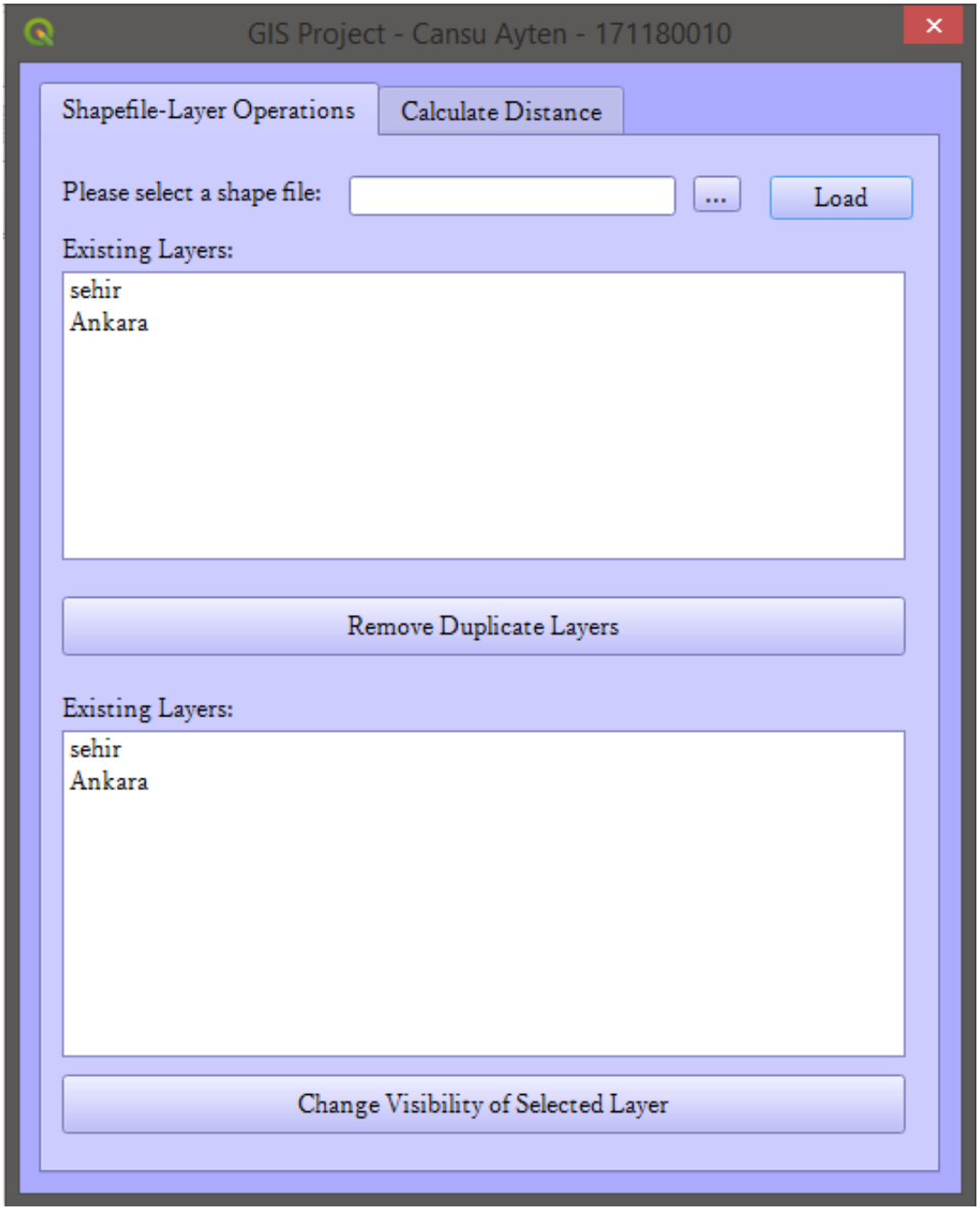

Figure 1:First Tab of the Plugin

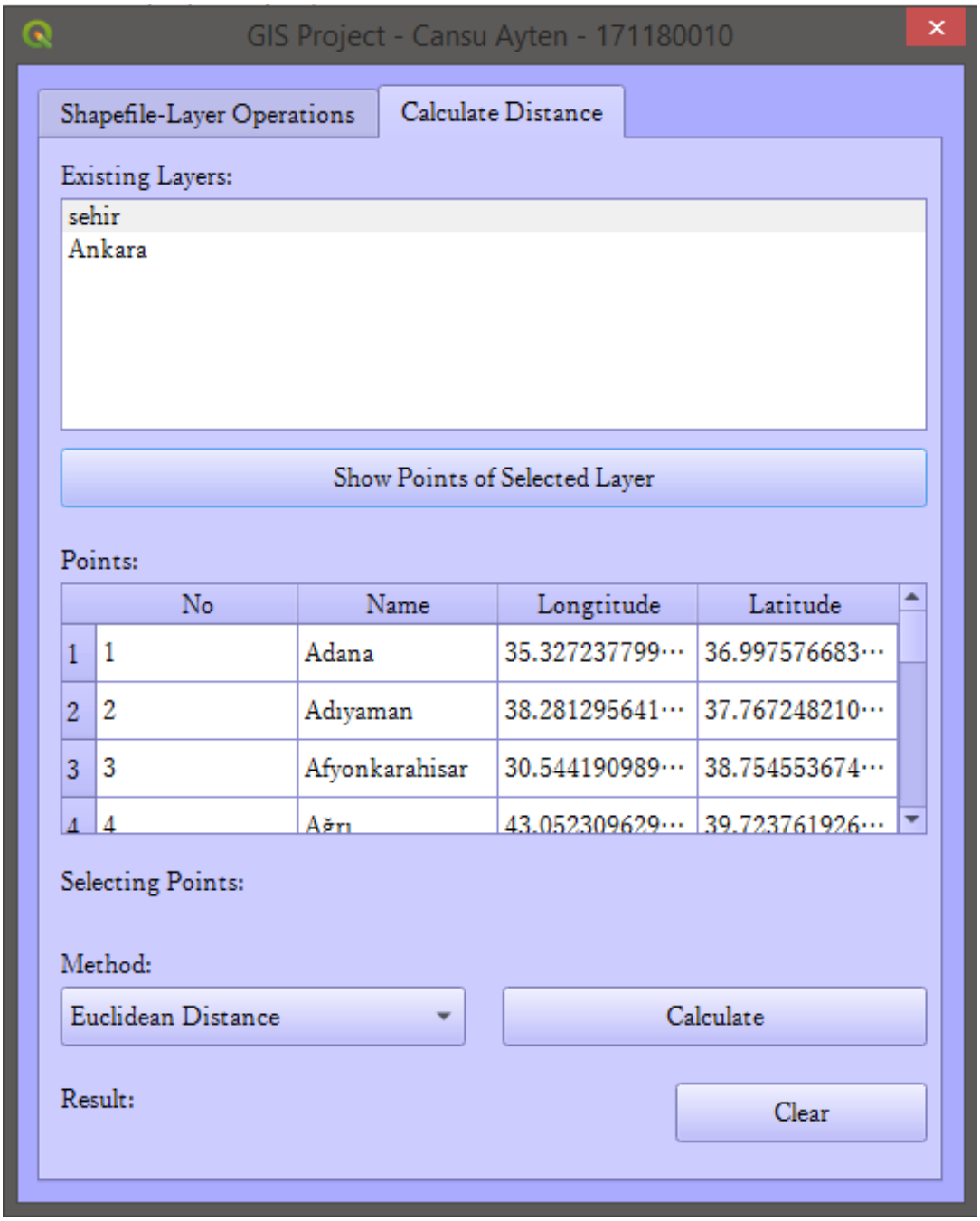

Figure 2:Second Tab of the Plugin

4.USAGE

4.1 Tab 1 – Shapefile – Layer Operations

4.1.1 Upload a Shapefile

After the plug-in is opened, the file system is accessed through the ToolButton on the screen in order to enable the user to select a file. On the screen that opens, only files with .shp extension are allowed to be selected. Once these files are selected, the geometry in them is also important. If the layer has point geometry, the file path is printed to the LineEdit next to the ToolButton. If the layer doesn't have point geometry, the plugin will give a warning "Invalid geometry type. Layer must be point geometry. " in a Message Box. The file path cannot be printed because a file cannot be selected in LineEdit. Clicking the Load button after selecting the appropriate type of file opens the layer in QGIS and displays it on ListView and ListWidgets. As soon as the layer is opened in QGIS, the file path in LineEdit is cleared and ready for the next processing.

4.1.2 Remove Duplicate Layers

If a layer has been loaded more than once via QGIS or the plugin, it may be desirable to leave only one of these layers. To do this, simply click the Remove Duplicate Layers button. After clicking this button, duplicate layers are both deleted in QGIS and removed from ListView and ListWidgets. ListView and ListWidgets continue to display the currently found layers. Only 1 of the duplicate layers remains in the program.

4.1.3 Change Visibility of Selected Layer

A layer selection is made by clicking once on the ListWidget on the Change Visibility of Selected Layer button. If the Change Visibility of Selected Layer button is clicked without clicking on any of the layers, "You must select a layer." warning appears in a Message Box.After clicking and selecting the layer once, clicking the Change Visibility of Selected Layer button under the ListWidget changes the visibility of the layer to be the opposite of the previous visibility state. If you keep clicking the same button without selecting another layer after the selection, the visibility of the last clicked layer, which is indicated with a slightly dark color on the ListWidget, changes. If another layer is selected, only the visibility of that layer can be changed by clicking the button.

4.2 Tab 2 – Shapefile – Layer Operations

4.2.1 Selecting Layer From a ListWidget

A layer selection should be made from the ListWidget, where the currently found layers are displayed. If the Show Points of Selected Layer button is clicked without selecting a layer, the "You must select a layer." warning is given. If the Show Points of Selected Layer button is clicked after clicking on a layer in the ListWidget, the points belonging to that layer are shown in the TableWidget located below. Before the selection is made, the Points table is empty.

4.2.2 Selecting Points

After clicking on one of the points on the TableWidget, which contains the points of the selected layer, this point is saved and shown in the Selecting Points Label. Likewise, after the second point is taken from the user, this point is shown in the Selecting Points Label along with the first point. If the user clicks one more point to select a third point, the selected points are reset. Then the user in a MessageBox "You must select two points. Please try again." warning is given. After this warning, the points in the Selecting Points Label are deleted and if the user wants to calculate, it is expected to click on the desired two points again.

4.2.3 Selecting Method and Calculating

After clicking only two of the points specified in the TableWidget, one of the methods in the ComboBox is expected to be selected. If the Calculate button is clicked without selecting the method, the calculation is done using the Euclidean Distance selected by default. The result of the operation is shown in the Result Label. If the Calculate button is clicked without selecting any points, the user will be prompted with a "You must select two points." warning is given in a MessageBox. In case the selected points are cleared or a new calculation is desired, the selected points and the results of the operations are cleared with the Clear button and become ready for use again.

5. APPLICATION STEPS

First, a plugin was created with Plugin Builder. A compile.bat file was written, saved and run by going to the created plugin directory. A tabwidget has been added using the Qt designer for the interface of our plugin, which is now included in the plugins in the QGIS environment. Two separate tabs have been created in this TabWidget.

This part of the code is implemented in the selectShapeFile(), loadFile() functions. In the function, file selection is made with QFileDialog. Here, only files with .shp extension can be viewed and uploaded by limiting the file extension. Then, the geometry of the layer to be loaded is checked. Since the application only accepts point geometry, it does not accept files with different geometry (line-polygon) and gives an error message to the user.

After loading the appropriate file selected, the layer can be viewed through a ListView. This is accomplished in the showLayersInListView() function. All open layers can be viewed by calling this function. If there is more than one layer with the same path, that is, there are more than one of the same layers, a function called removeDuplicateLayers() was written. So that only one of these layers remains. It has been determined that the file paths are different after adding the same file twice through the QGIS environment and the plugin interface. It turns out that one path contains '\\' while the other contains '/' instead. This situation has been corrected in the removeDuplicateLayers() function, ensuring that the function works correctly regardless of the loaded location. At the end of the function, the widgets where the layers are displayed are updated.

Existing layers are also displayed via ListWidget. The showLayersInListWidget() function provides the display operation in ListWidget. The clear function has been applied to the ListWidget to delete the already written layers. Later, the open layers were made into an array and added to the ListWidget again.

The purpose of using ListWidget in the first tab is to change the visibility of a selected layer. The function that provides this is the changeVisibiltyOfSelectedLayer() function. In the function, the id of the selected layer is taken from the ListWidget. After clicking the Change Visibilty of Selected Button, the visibility of the layer changes to be the opposite of the previous state.

In the second tab, the points on the layers and the areas where operations can be applied to these points are designed. First, the layers are displayed in a ListWidget as in the first tab. The points of the selected layer in this ListWidget are displayed in a TableWidget after clicking the "Show Points of Selected Layer" button. The function that finds the points is findPoints() function. In this function, id and name properties are taken together with the latitude and longitude of the points in the layer and placed in an array. In the showPoints() function, the points in this array and their properties are printed on the TableWidget.

Two points can be selected from within the TableWidget. If more than two points are selected, an error message is given to the user and the selected points are reset, prompting the user to select a point again. These selected points are printed on a label on the interface. These operations are done inside the selectPoints() function. Then, after selecting a method from the ComboBox, where there are two calculation methods, calculations are made in accordance with the method by clicking the calculate button. These operations are performed in the calculateDistance() function. Two methods are presented. The first method is the Euclidean Distance and the second is the Manhattan Distance. These two methods calculate the distance between two points in different ways. Euclidean Distance finds the distance between two points as air distance. Its formula is (x1,y1) the first point and (x2,y2) the second point; $\sqrt{(x2-x1)^2+(y2-y1)^2}$ is the equation. Manhattan Distance, on the other hand, creates the path between two points in a way that creates a perpendicular angle to the axes when the coordinate axes are considered and finds the distance accordingly. Its formula is (x1,y1) the first point and (x2,y2) the second point; |x1 - x2| + |y1 - y2| is the equation.

The adaptation of these two equations to the project was made by considering the structure of the world. That is, the latitude and longitude coordinate data we obtain are used to measure distances in km, taking into account the distances between them.

The calculated result is displayed in the Result Label. The clear() function has been written to make the TableWidget look clean during the opening of the application and all rows in the TableWidget have been deleted.

With Clear Button, the Selecting Points Label, the selected points, and the Result Label are cleared. These operations are done within the clear_selecting_points_result() function.

Since most of these events need to be clicked on the ToolButton, Load, Remove Duplicate Layers, Change Visibility of Selected Layer, Show Points of Selected Layer, Calculate and Clear button, the corresponding functions are called within the run function. As soon as the plugin is opened, the layer display functions are also called within the run function so that the already attached layers can be displayed.

Two layers have been created over QGIS. These layers have point geometry. While one of the layers shows the provinces in Turkey, the other layer shows the districts in the Ankara province. Both have two attributes in their attribute tables, id, and name. By using these two layers, it was checked whether the plugin works by the purpose.