

# Advanced GIS Programming Final Project Report



## Closest UTD/883 Bustop Analysis for UT Dallas Students

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## 1. Inspiration:

This project idea was originated by keeping in mind the need of transportation facility for the international students who wants to commute back and forth from the university and also their confused situation about reaching a specific Bustop during the peak hour of classes.

## 2. Objective:

The objective of this project was to find out the nearest bus stops available for the students from their respective apartment communities in the UTD neighborhood area. Once the student selects the side where he live and also gives the apartment name, the graphical user interface in the ArcMap will highlight that respective apartment community and also the nearest Bustop to it. In addition for performing the reverse engineering, the Thiessen polygon creation is carried out which gives the area nearest to Bustop.

## 3. Software Packages used:

In order to map the Apartment Communities, Bus stops, UTD bus routing system and also to find out the nearest Bustop programmatically, following software packages have been used.

- ArcGIS Pro
- ArcMap
- Arc Objects Programming using Vb.net

## 4. Background:

Before delving much into the data collection details and methodology of this project, let us have a brief background about the UTD bus routing system. The UTD bus routing system has 4 major start/stop points. They are:

- Cityline/Bush Station (883 E)
- Dickerson & McCallum Blvd intersection (883 W)
- McCallum Express Route
- Cityline/Bush Express Pilot Route (Mon-Thu)

There are 5 major Bus routes in which the students commute to the university. They are

- DART 883 West Route
- DART 883 East Route
- McCallum Express Route
- CityLine/Bush Station Express Pilot Route.
- DART 883 West Extended Walmart route(Fri, Sun)

The target areas under consideration are the apartment communities where most of the international students live both on the east and west side of the university. Following are the apartment areas considered on the east and west side.

### **East Side Apartments:**

Marquis of Waterview, Pradera Apartments, Alta Creekside Apartments, Prairie Creek Villas, Home of Prairie Springs

### **West Side Apartments:**

Gables on McCallum, Chatham Courts, Chatham Reflections, McCallum Glen, McCallum Crossings, McCallum Corners, McCallum Courts, Estates on Frankford

## 5. Data Collection:

The data collection for this process was a bit intense. There was no readily available data in order to proceed with the analysis for this project. Hence, I tried to map the UTD Bus Routing System, the 883 Bus Stops and also the Apartment Communities on both the east and west side of the University of Texas at Dallas. This mapping process was carried out in ArcGIS Pro with the help on the Open Street Base Maps and also the Bing Maps for mapping the Bustop information. All the Bustop information was gathered from the DART website [www.dart.org](http://www.dart.org)

## 6. Methodology:

The methodology adopted for this project is the usage of the Geoprocessing “Near” Tool in order to find out the nearest Bustop through Arcobjects Vb.net programming.

### 6.1 Near Tool Usage

It is used for calculating distance between the input features and the closest ones. It also gives additional proximity information. It will be able to find closest point or polyline or polygon when an input feature class is given.

Following fields will be added to the input once the near tool is executed.

**NEAR\_FID** --> ObjectID of the closest feature

**NEAR\_DIST** --> Distance between features if it is within the search radius, else -1 is assigned

**NEAR\_FC** --> Only if multiple near features are specified.

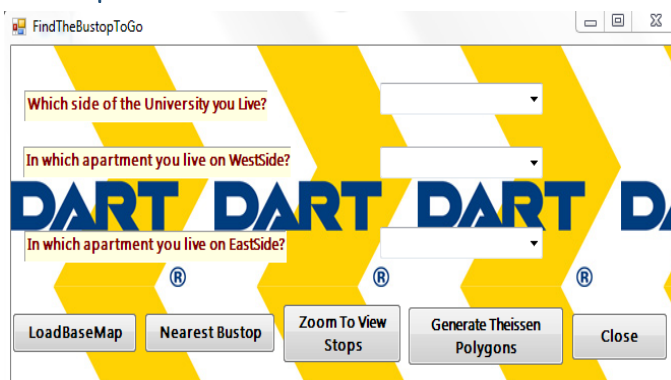
**NEAR\_X** --> X-coordinate of the near feature location


**NEAR\_Y** --> Y-coordinate of the near feature location

**NEAR\_ANGLE** --> Angle of the line at the FROM\_X and FROM\_Y location which connects the input features to the near feature.

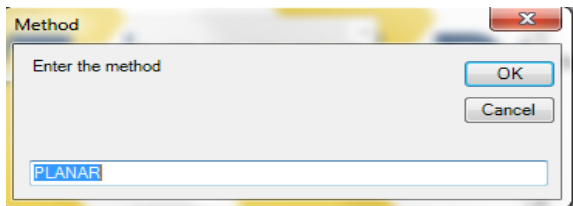
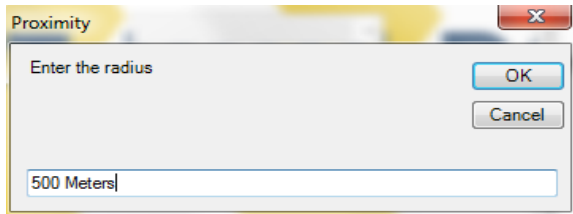
The beauty of this tool lies in allowing us to specify the search radius for finding the closest facilities of different geometry types. It also gives us an option to select the Planar or Geodesic Method for calculating the distances.

### 6.2 Snapshot of the form created.

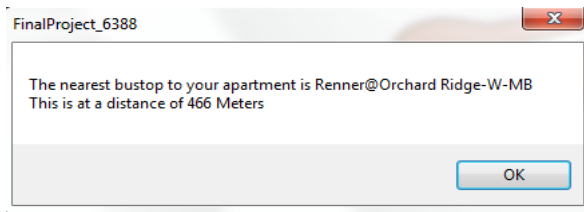


An ArcGIS add-in button (  ) has been created using the vb.net programming in ArcObjects, so that when a user clicks on the add-in button a windows form pops up asking to select East or West Side and also the corresponding Apartment Name where he lives.

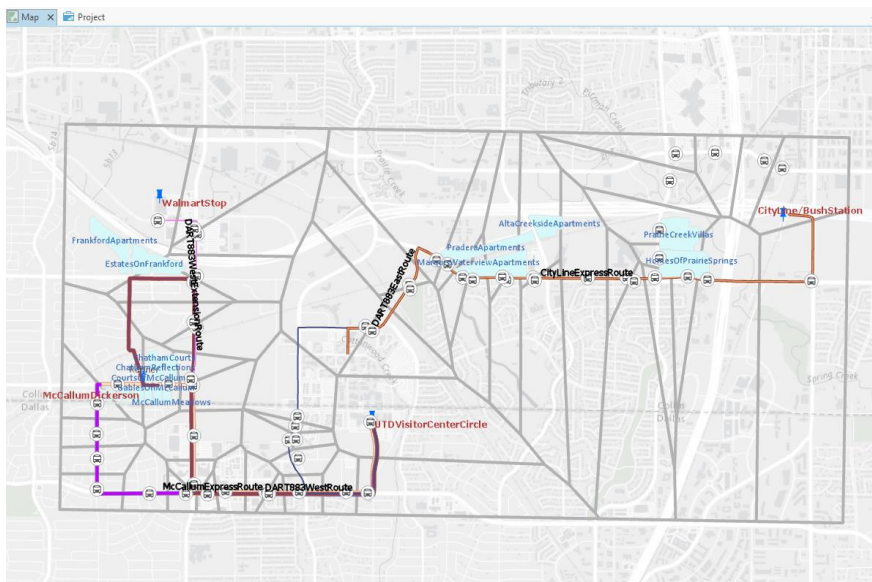
Once these options are selected, the user can choose to load the base map, then find the nearest Bustop to the selected apartment. The user will be given option to enter the search radius criteria and also the method for calculating the distance (Planar or Geodesic) as shown in the below screenshots.



Now the after selecting these two options a message box pops up as shown below giving the details of the closest Bustop and also the distance of this Bustop from his apartment. Both the Apartment and the nearest Bustop will be highlighted. You can view them by zooming into the contents after clicking on Zoom button.



To perform a concept of reverse engineering, this time I took our Bustop points as Input features and created Thiessen Polygons based on that. So, all the people residing in that particular polygon area demarcated can reach the Bustop in that polygon. In this analysis, there is no search criteria where we specify radius as that of Near Tool. Hence it is a bit faster and provides quick approximate polygon area.



## 6.3 Tools used in Forms in Vb.net

ComboBoxes, Labels, Buttons

## 6.4 Libraries used in ArcObjects.

Following libraries have been used in ArcObjects during this search process.

```
Imports ESRI.ArcGIS.ArcMapUI
Imports ESRI.ArcGIS.Carto
Imports ESRI.ArcGIS.Catalog
Imports ESRI.ArcGIS.CatalogUI
Imports ESRI.ArcGIS.Geodatabase
Imports ESRI.ArcGIS.Framework
Imports ESRI.ArcGIS.Geoprocessor
Imports ESRI.ArcGIS.Geometry
Imports ESRI.ArcGIS.Display
Imports ESRI.ArcGIS.DataSourcesGDB
Imports ESRI.ArcGIS.AnalysisTools
Imports ESRI.ArcGIS.esriSystem
Imports System.Windows.Forms
Imports System.Drawing.Image
```

## 6.5 Interfaces used in ArcObjects:

IMxDocument	IMap	Geoprocessor
IWorkspaceFactory	FileGDBWorkspaceFactory	IFeatureWorkspace
IFeatureWorkspace	IFeatureLayer	IFeatureClass
IQueryFilter	IFeatureCursor	IFields
IFeature	IFeatureSelection	

## 7. Final Products in ArcGIS Pro and ArcMap.

The final product obtained will be an Apartment Community and also the nearest bustop to it which are highlighted and these are clearly depicted in the Appendix section.

## 8. Limitations and Future Work

To carry out the network analysis in Arc Objects and perform closest facility analysis depending on the drive time and also the drive distance programmatically. This project considered the distance to be Euclidean which in some cases may not be giving fruitful results. Hence, I would like to develop a network dataset with all this data and program in such a way that it retrieves the nearest Bustop and also the path to it by using the network distance as the parameter.

## 9. Learnings and Findings

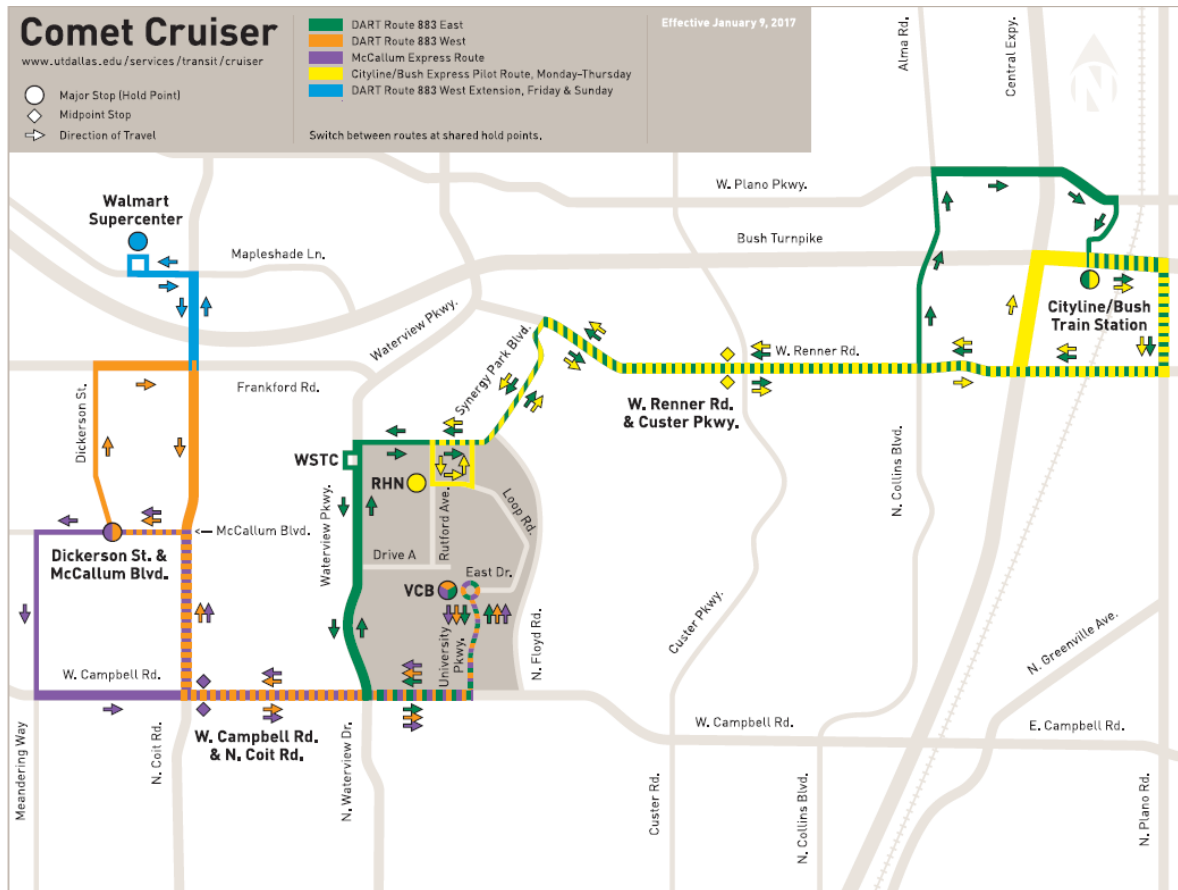
Using this project I learnt how to implement the concept of geoprocessing tools programmatically in Arc Objects. I was able to solve the existing UT Dallas student bus routing problems in order to find the nearest Bustop for them to reach. This will make them to reach the class at the right time without any hassles.

## 10. References

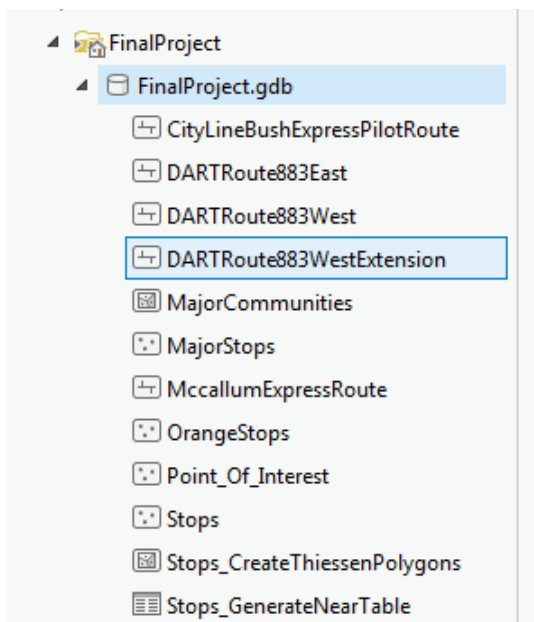
1. Chang, K-T., 2005, *Programming ArcObjects with VBA: A TaskOriented Approach, 2nd (ed.)*, CRC Press LLC, ISBN: 9780849392832
2. *ArcObjects Help for .Net Developers*, Retrieved April 20, 2017, from <https://desktop.arcgis.com/en/arcobjects/latest/net/webframe.htm>
3. Dr.Chun Yongwan, E-Learning UT Dallas, Lecture Notes, *GISC-6388 Advanced GIS Programming*

# 11. Appendix

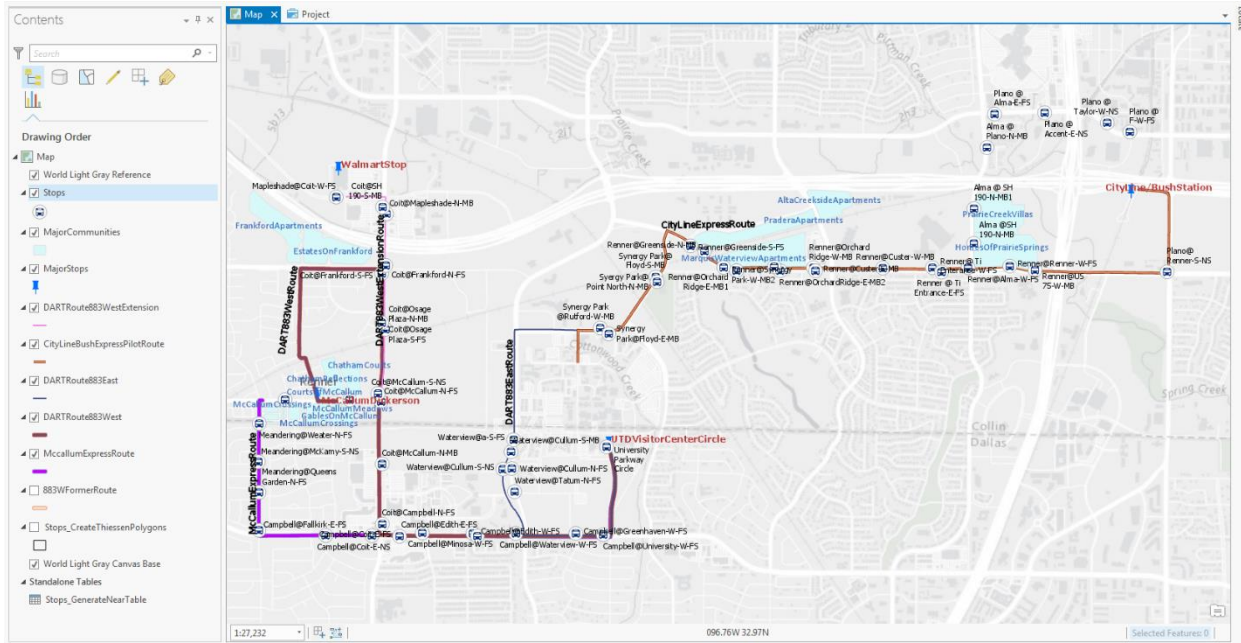
## A1.UTD Bus Routing Comet Cruiser Map



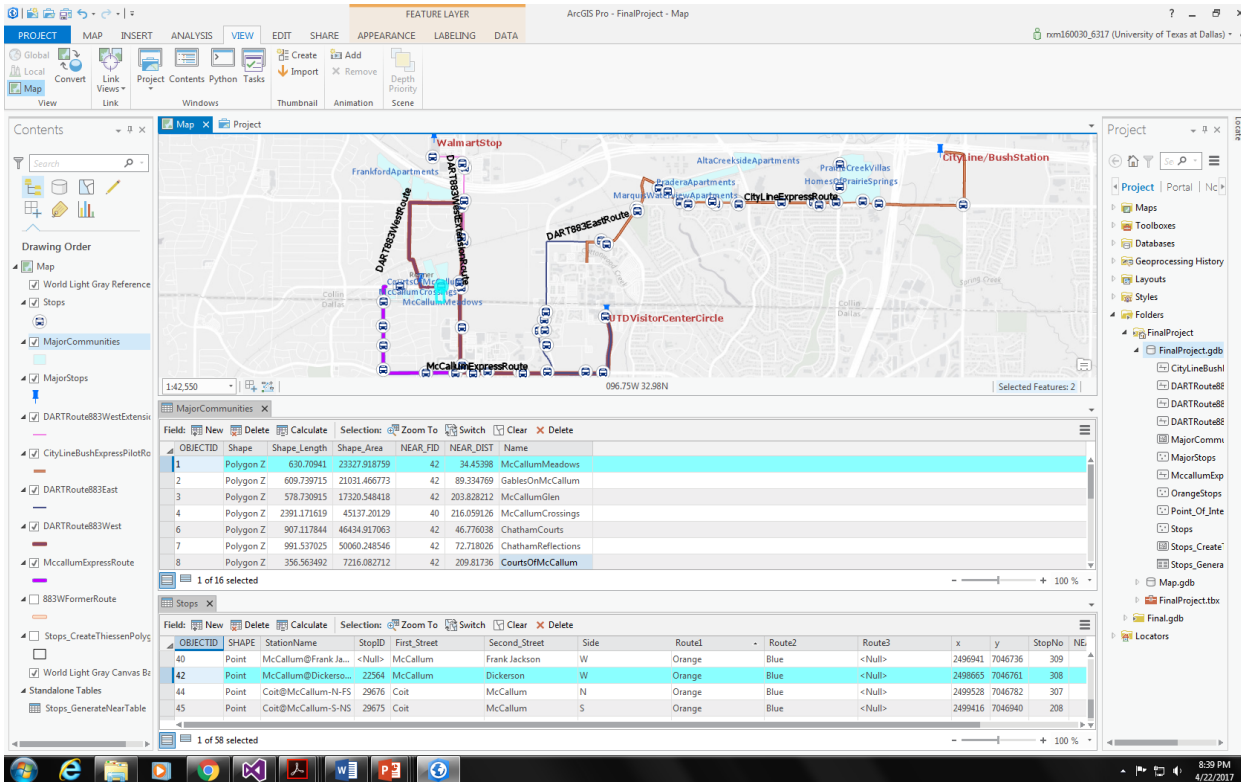
## A2.Geodatabase Created in ArcGIS Pro for Mapping Routing Information



### A3. Mapped UTD Routing System in ArcGIS Pro



### A4. Map depicting the closest Bustop to the housing community in ArcGIS Pro





A5. Map Layout depicting the Apartments, Bustops and UTD Bus Routing

