3-D Virtual Maps Production for Mosul City by USING GIS Techniques

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Received on:16/4/2008
Accepted on:31/12/2008

Abstract

With the developments in digital image processing techniques, 3D models of objects are transferred to the digital form from the hardcopy form. 3D visualization was performed by using Erdas Imagine Virtual GIS module. The model was enhanced with huge additional data. Since the model covers a very huge area of Mosul city, more information was added to the model to show the location names.

Also local services and road network was superimposed to the visualization. As a result of research, a user can fly over all Mosul city, may watch the topography, towns, local services places by using this model ,also the final 3d digital map contain all necessary information for users and designers to reach to the best decision.

Keywords: GIS, 3-D Map, DEM

انتاج خوارزمية ثلاثية الابعاد لمدينة الموصل باستخدام نظرية المعلومات الجغرافية

الخلاصة

مع التطور الحاصل في مجال تقنيات الصور الفضائية الرقمية, النماذج ثلاثية الابعاد للعوارض حولت الى الشكل الرقمي المأخوذ اصلاً من الشكل الورقي. الرؤية ثلاثية الابعاد نفذت بأستخدام برنامج Erdas Imagine Virtual GIS.

النموذج المستخدم أثري بالبيانات الاضافية الضخمة.كون النموذج يغطي مساحة شاسعة من مدينة الموصل الكثيرمن المعلومات أضيفت للنموذج لمعرفة أسماء المواقع , كذلك الخدمات العامة و شبكة الطرق تم تسقيطهما للرؤية ثلاثية الابعاد .كنتيجة للبحث المستفيد منه بأمكانه النظر لمدينة الموصل و كأنه يطير وممكن ان يراقب التضاريس والقرى والخدمات العامة المسقطة بأستخدام النموذج المنتج. أخيرا الخارطة ثلاثية الابعاد المنتجة تحوي كل المعلومات الضرورية للمستخدمين و المصممين لأتخاذ القرار الامثل.

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1. Introduction

The need for 3D information is rapidly increasing. Currently, many human activities, i.e. urban planning, cadastre, environmental monitoring, telecommunications, public rescue operations, landscape planning, transportation monitoring, real-estate market, hydrographical activities, utility management, military applications, make steps toward third dimension[1]. 3D visualization within 3D GIS requires appropriate means to visualize 3D spatial analysis, tools to effortlessly explore and navigate through large models in real time. Observations on the demand for 3D City models show user preferences for photo-true texturing. Trading photo-true texture brings up necessities to store parameters for mapping onto the geometry.

The virtual GIS is very important in monitoring large city such as Mosul city it can be made use of its facilities easily. The objectives in this research can be summarized as following:

- watching the topography, cities, local services places easily
- Creation of Digital Elevation Model
- To view entire Mosul city in 3D by draping the required vector & raster layers on the DEM
- To drape the DEM and LANDSAT 7ETM+ dated in 2007 (band1, 2, 3) see fig.1 data of Mosul city on the study area and to view in Virtual GIS.

2. Classification of Mosul Satellite Image:-

Maximum likelihood classification is supervised classification. It first determines the distributions of the DN (digital number) values in each band for each class. Each unknown pixel is then assigned to a class based upon Gaussian probability.

Although it is expensive, modern computers allow it to be widely used [2]. In cases where a pixel may fall into the overlap region of two or more AOIs (Areas of Interest) it must defined how the pixel can be classified. See fig.2 that represent classified image of Mosul city [3]

3. Construction of DEM Using Contour Map

The contour layers that exist on the topographic map of the study region have been used to produce the required (DEM), the accuracy of the resulted DEM depends upon the contour interval, scale of the map and the amount of the terrain variations in the region under investigation. Surface modeling is a general term which is used to describe the process of representing a physical or artificially created surface by means of a mathematical expression. Terrain modeling is one particular category of surface modeling which deals with the specific problems of representing the surface of the earth. The techniques of terrain modeling are of widespread use and have been app1ied widely in the physical and earth sciences. Digital representations of the terrain often form one of the main elements of the mapping process. By using ERDAS 9.0 and contour map (1/20000) scale for Mosul city the DEM is built fig.3.

4. GIS techniques & Mathematical concepts

Topographic data are usually expressed as a series of points with X,Y, and Z values.

When topographic data are collected in the field, they are surveyed at a series of points

including the extreme high and low points of the terrain along features of interest that
define the topography such as streams and ridge lines, and at various points in between.DEM is expressed as regularly spaced points.
To create DEM file, a regular grid is overlaid on the topographic contours. Elevations are read at each grid intersection point, as shown in (fig 4a) .IMAGINE Virtual GIS is a 3D visualization tool. It allows roaming of large databases with "real time" performance.
Multiple layers of raster, annotation, and vector imagery can be viewed and queried within a virtual environment [4] see (fig. 4b-c).

4.1Accuracy Assessment of DEM

By using triangulation stations in the topographic map as reference check points and recording the same locations for these points in DEM relative error between them will be calculated as shown in Table 1.

5.1 3D Model Layers

Model layers allow you place true 3D models and vertically displayed raster images
(usually JPEG images) in a VirtualGIS scene. The layer must be added prior to importing any models, creating a file with a .vml extension. When importing the model, there are two position options:

• Model's Geographic Coordinates
• Current Viewing Position

Model's Geographic Coordinates places the model in its correct position in the image, based on the coordinates associated with the model. Many models, however, do not have their own geographic coordinates. Once placed, the model can be selected and moved within the VirtualGIS Viewer [5] see fig.6.

5.2 Vector Layers

Individual vector layers may be added to IMAGINE VirtualGIS after an elevation model is displayed. Vector arcs and polygons can be displayed in two ways:

• Draped over the terrain of an elevation model
• Displayed as 3D objects on an elevation model

The 3D objects have vertical sides, and their shapes are based on the shape of the depicted polygon or arc. Arcs appear as 3-dimensional "fences;" polygons appear as 3dimensional buildings. The polygon attribute table must have a column containing numerical values for defining the height of each polygon; the height value must use the same units as the elevation model, and the base of the polygon is placed on the "ground" (surface) of the elevation model.[7] Both modes of display support vector properties, symbology, and attribute querying. Draped vector layers must be processed by the Virtual World Editor when they are added to a Virtual World directory. If a draped vector layer is not part of a Virtual [6]. See fig.7 (a-d).

5. Conclusions

- The use of Virtual GIS give accurate measurements depend on the accuracy of the digital elevation model (DEM)
- With the help of the computer technology, large cities can be properly monitored. The computer technology enables everybody to use such geographic materials easily.
- With VirtualGIS, it is able to acquire a spatial understanding of the terrain by flying over and driving

across the landscape. Along the virtual trip, users can be query facilities on local services and site specific data. The creation of the virtual world was a simple process, only requiring reliable remotely sensed data, vector information, occasionally registration refinements, and an adequate computer system.

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Table 1 Relative Error between real heights and DEM

point	Easting m	Northing m	Z Measured m	Z Calculated m	Individual Relative error %	Mean relative error %
1	328483.00	4017302.29	263.00	263.76	0.300	0.36
2	325255.00	4017417.89	331.00	330.00	0.306	
3	325489.00	4027554.18	279.00	276.00	0.354	
4	325923.00	4031929.60	245.00	240.65	0.144	
5	326008.00	4029500.92	225.00	226.46	0.633	

Relative Error i= │ (Z meas. i –Z calcu. i)/(Z meas. i) │*100 % (1)

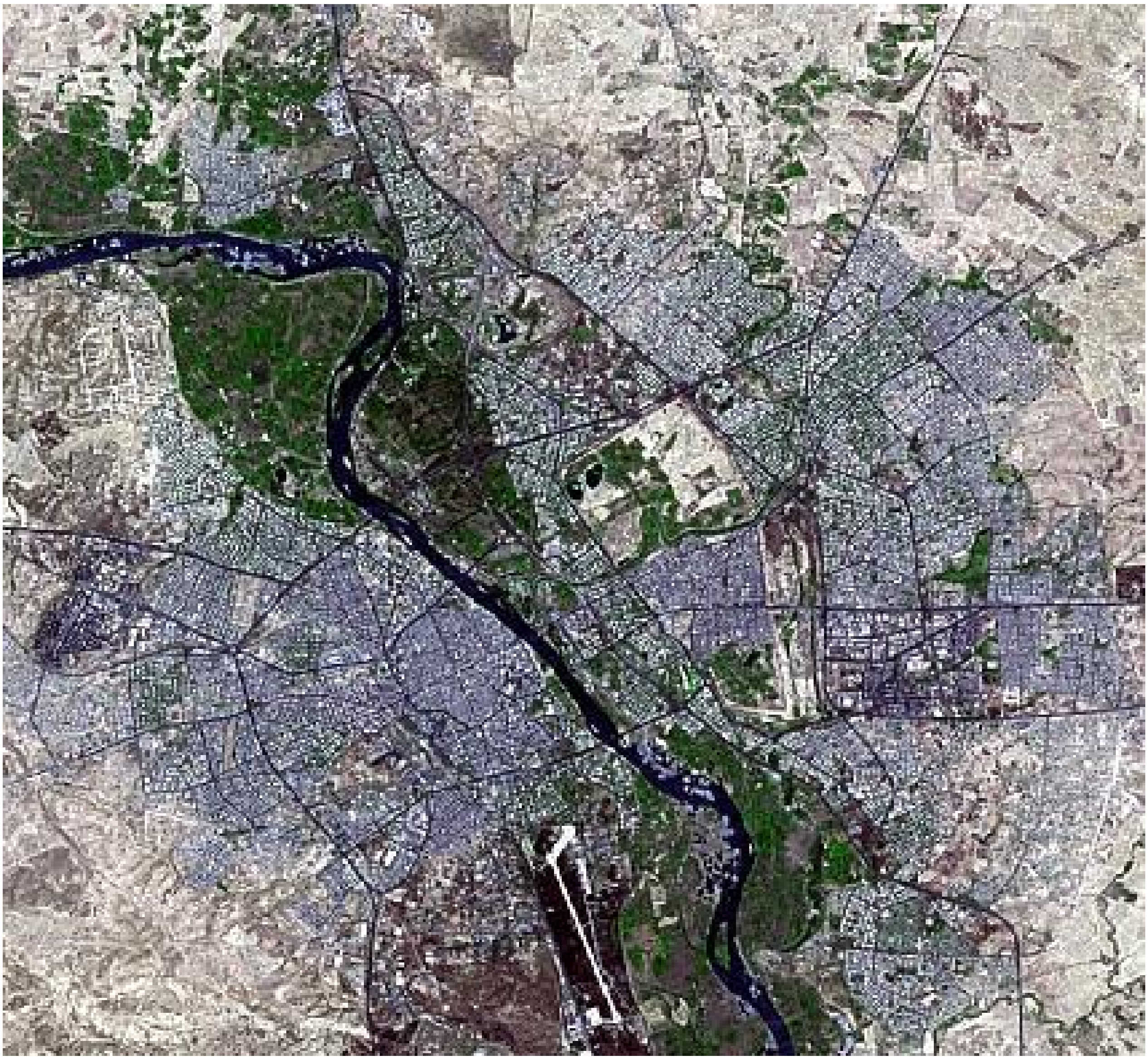

Fig.1. Satellite Image of Mosul City (LANDSAT 7ETM + _28.5 M Resolution)

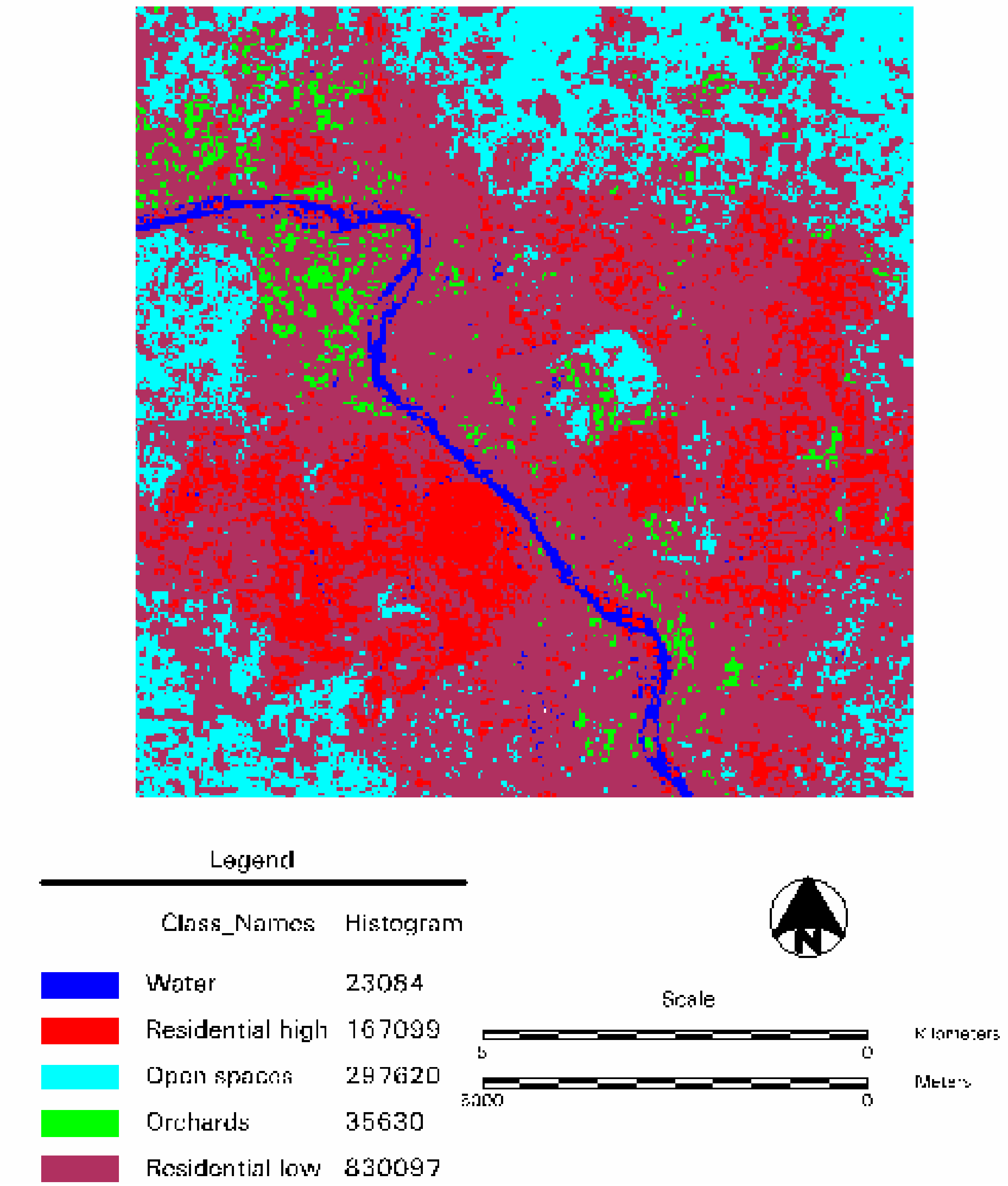

Fig.2. Supervised classification _ Maximum likelihood method for

Mosul city Satellite Image

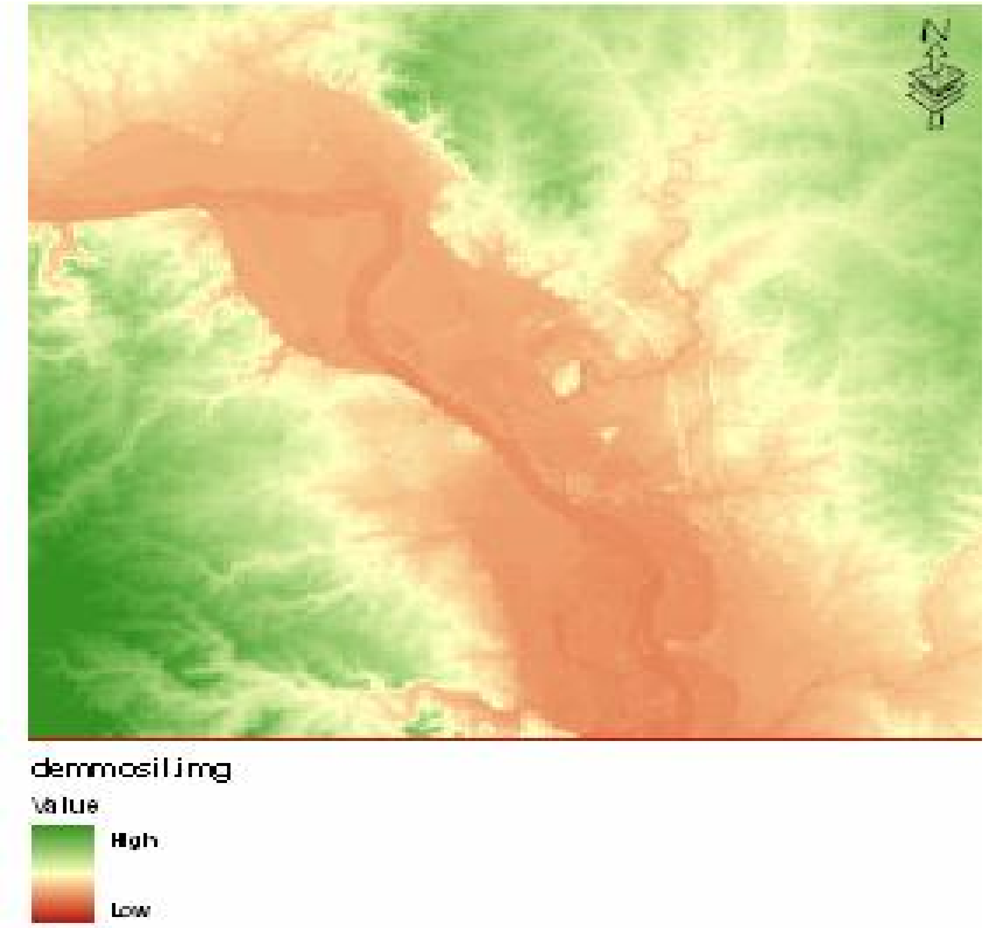

Fig.3. Digital Elevation Model (DEM) of Mosul City

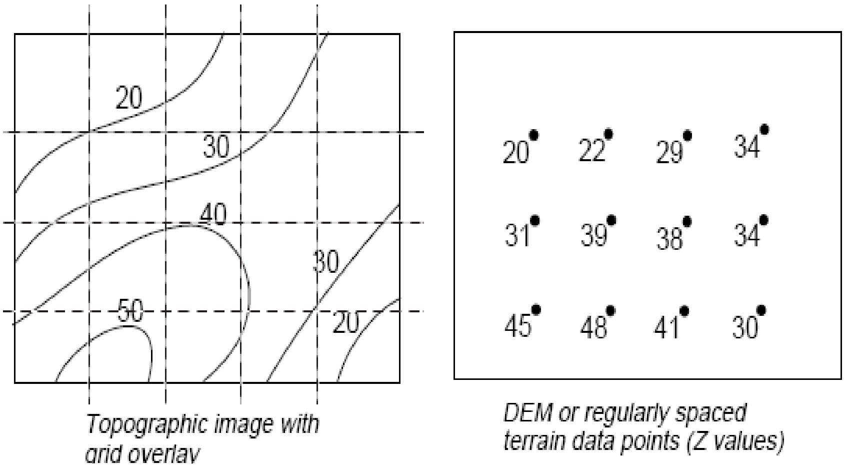

Fig .4a. Regularly Spaced Terrain Data Points

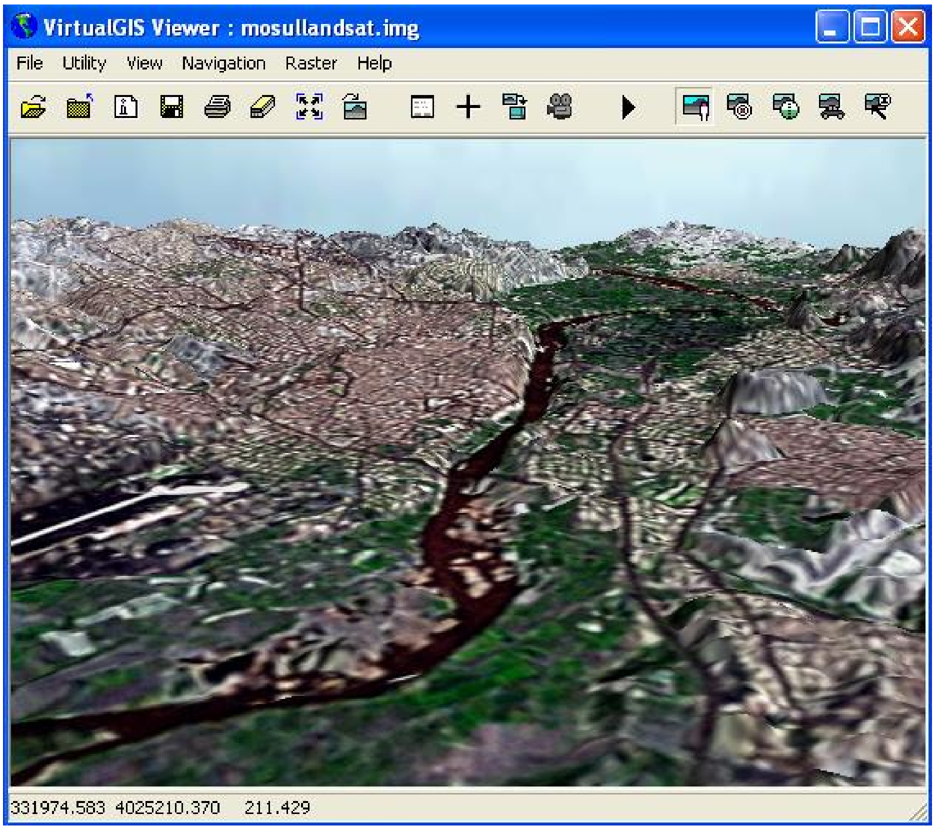

Fig.4b. 3D Visualization of Mosul City

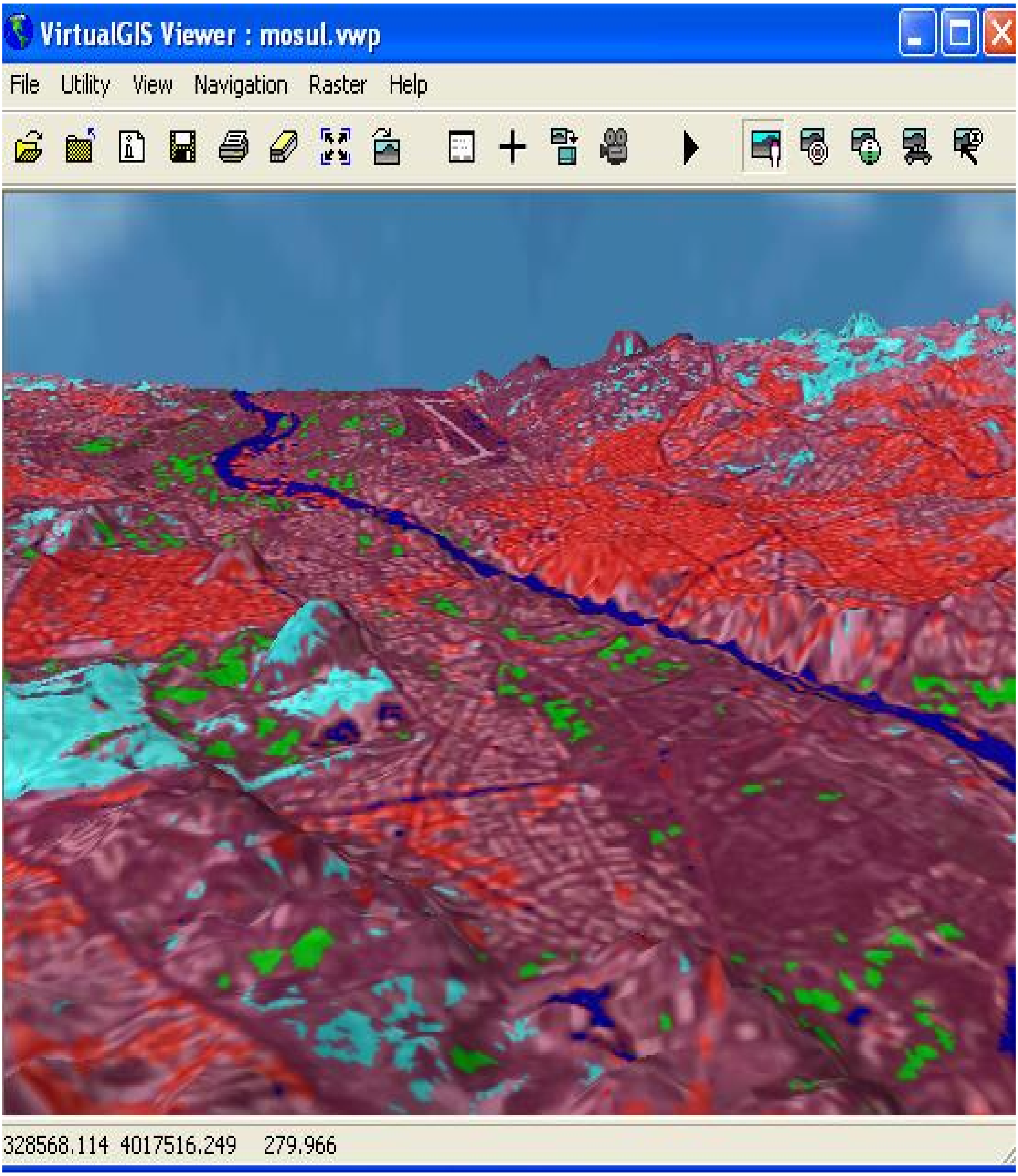

Fig.4c. A Classified Satellite image of Mosul City has been draped over the terrain DEM

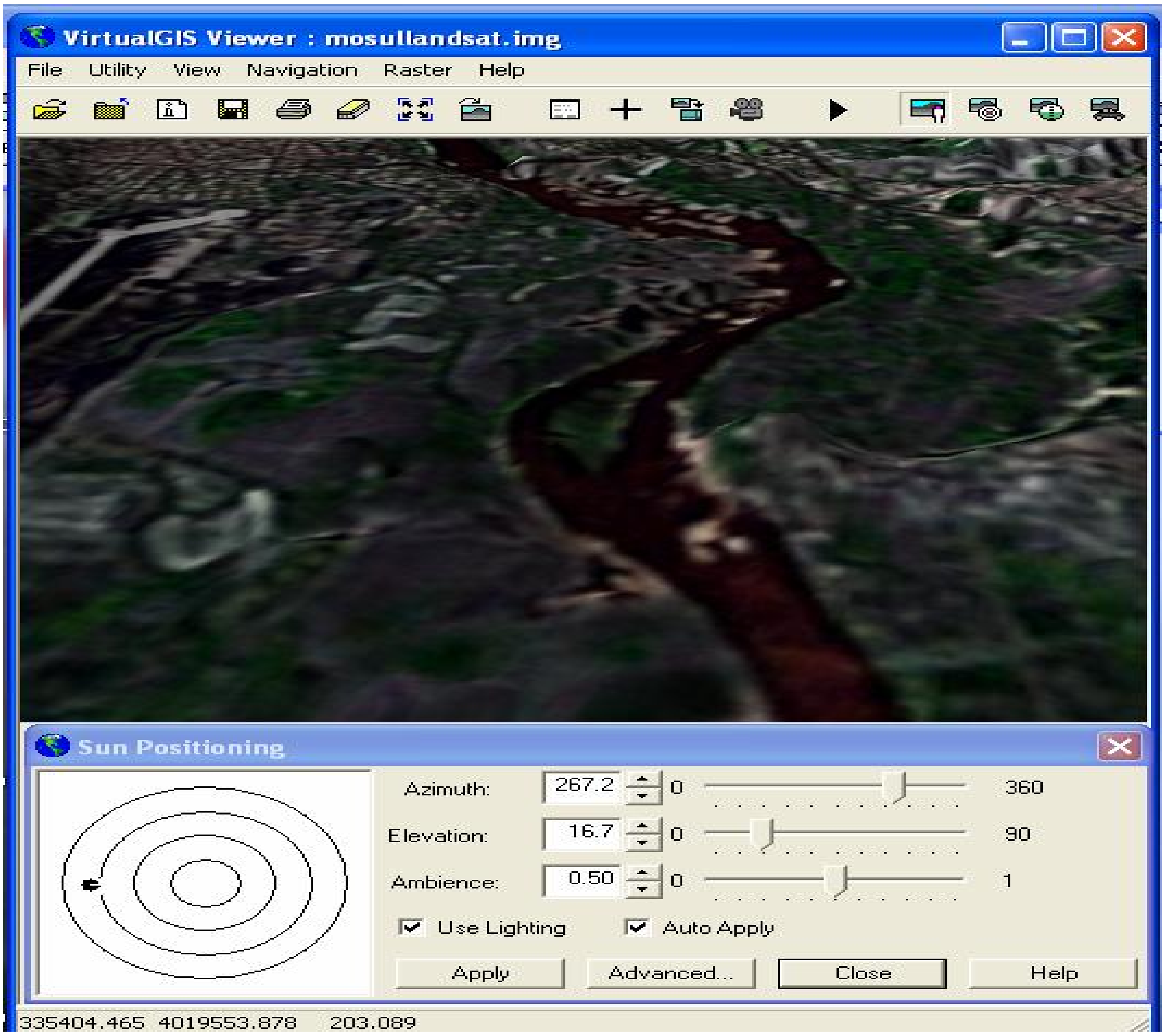

Fig.5a. 3D Visualization of Mosul City represents sun position in the date1700\9\April\ 2007

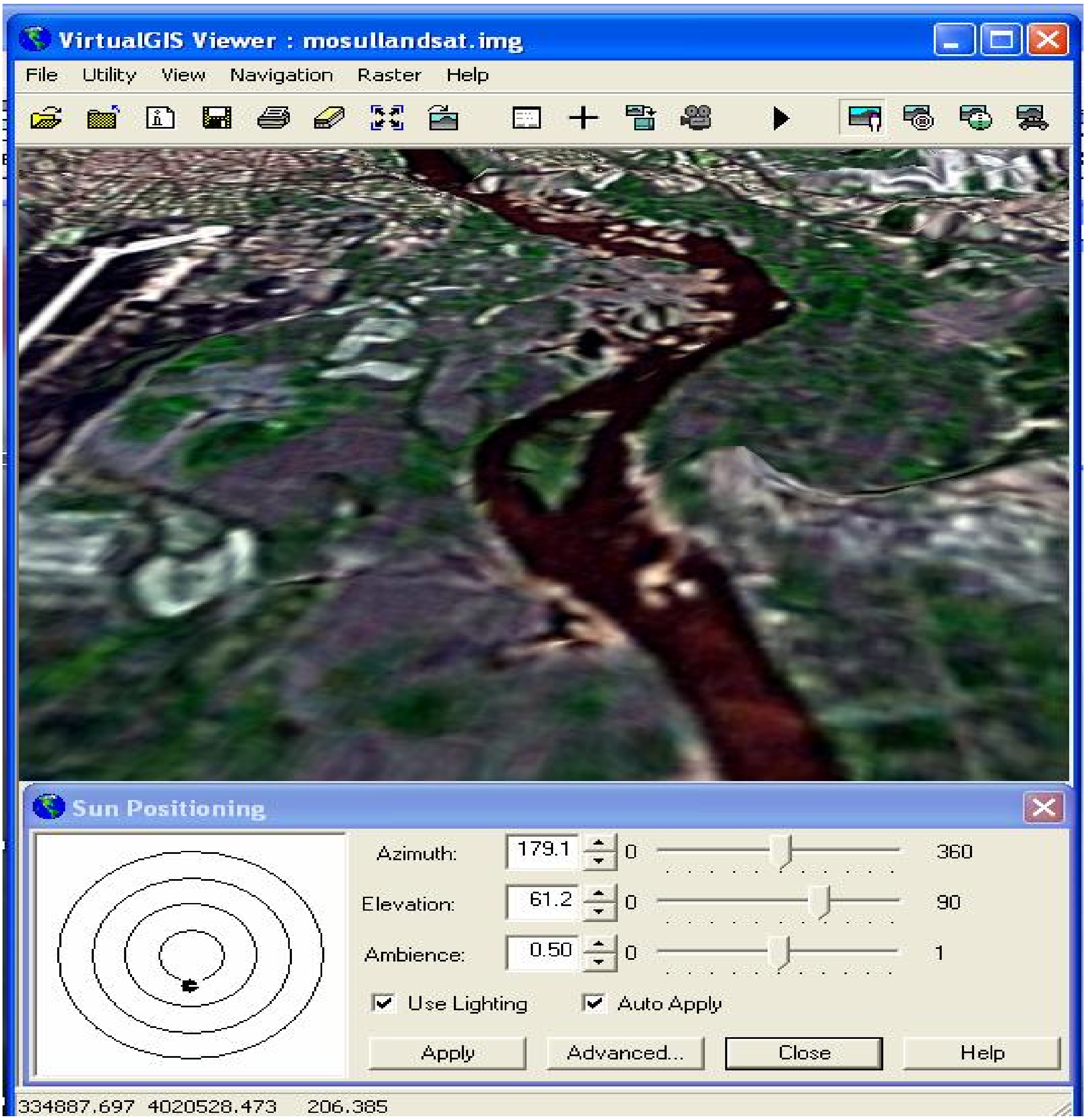

Fig.5b. 3D Visualization of Mosul City represents sun position in the date1200\9\April\ 2007

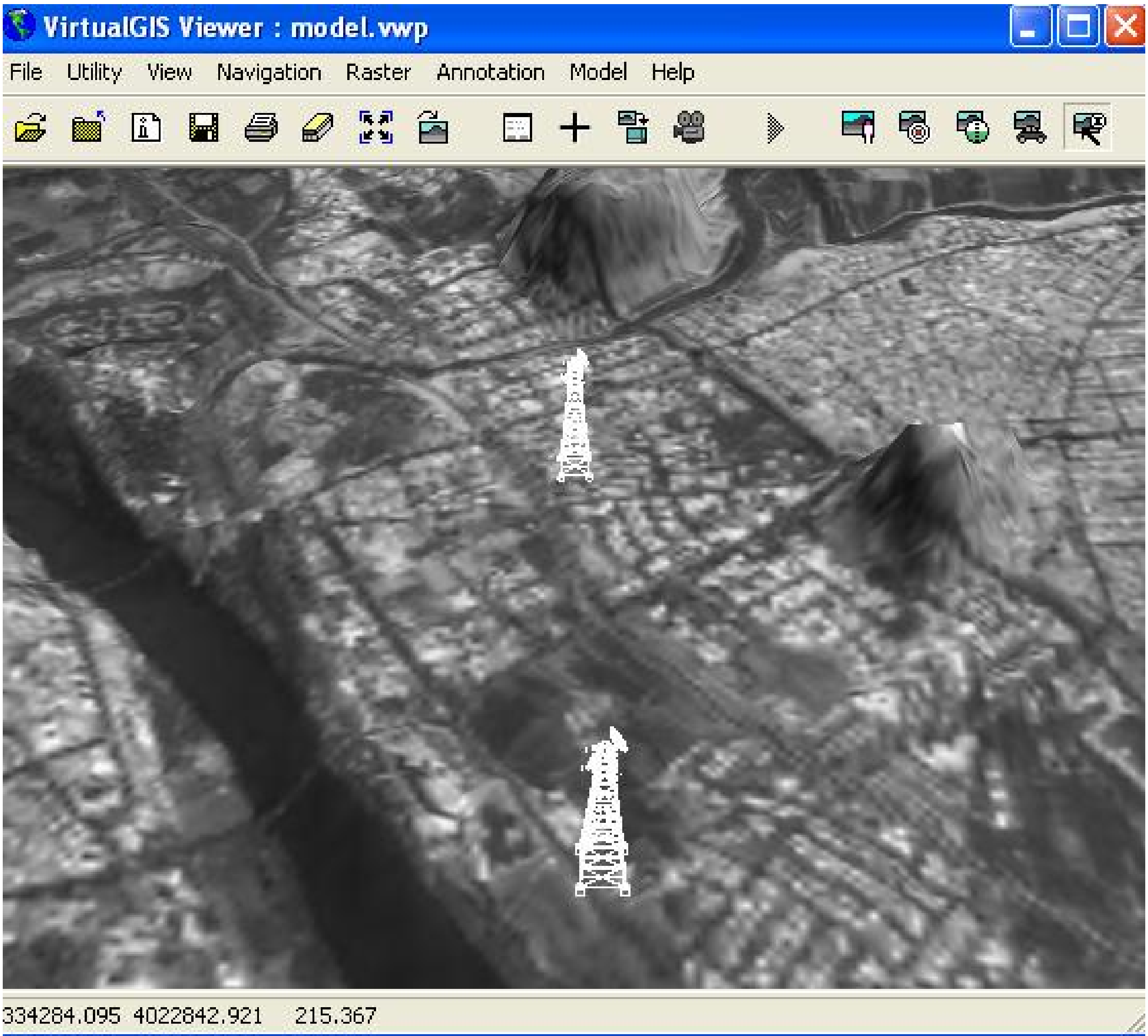

Fig.6. Two communication facilities have been located by using3D Model Layers for Mosul City

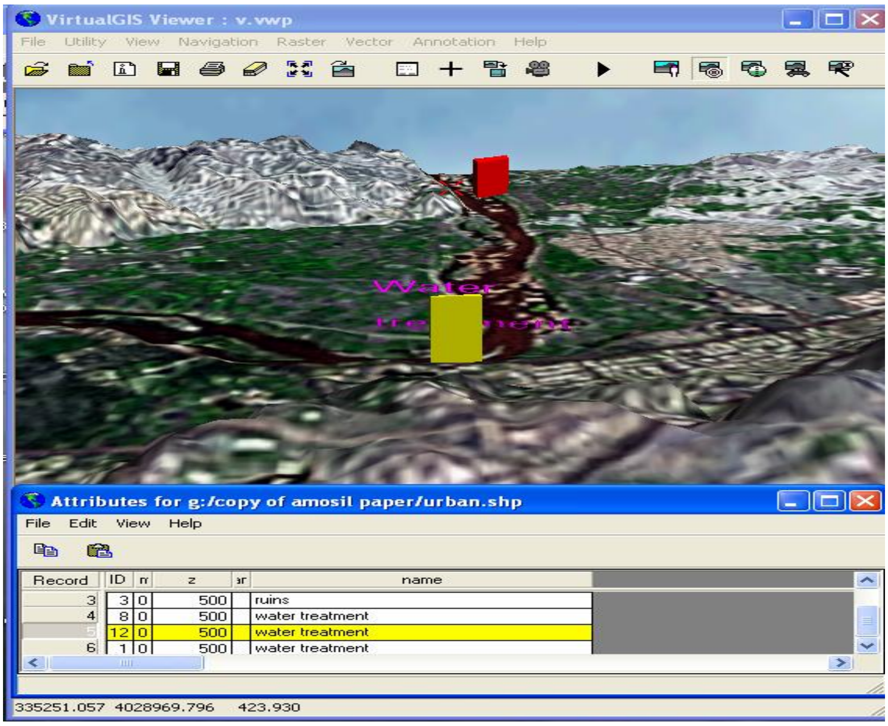

Fig.7a.Vector data represent water treatment unit have been draped over the DEM.

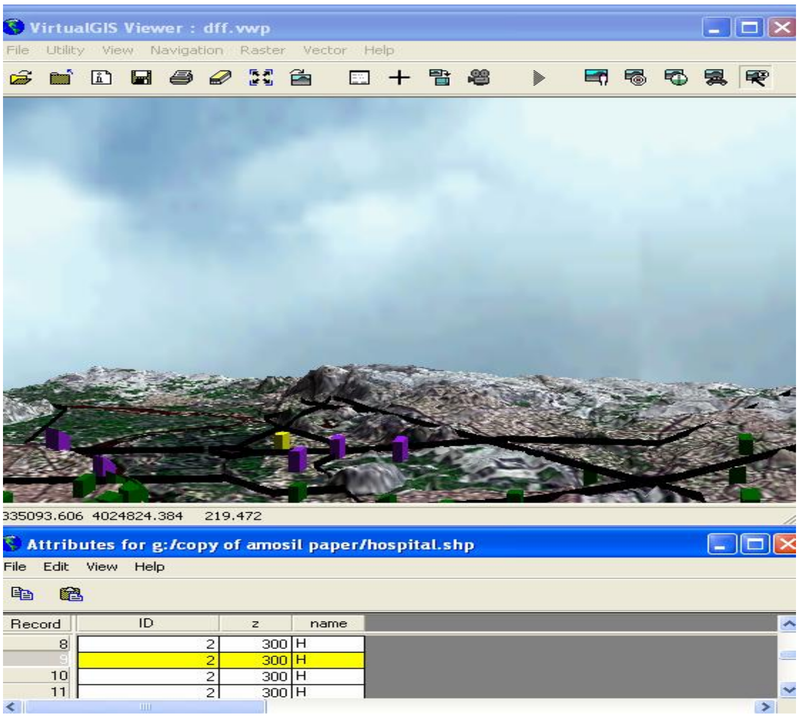

Fig.7b.Vector data represent hospitals have been draped over the DEM.

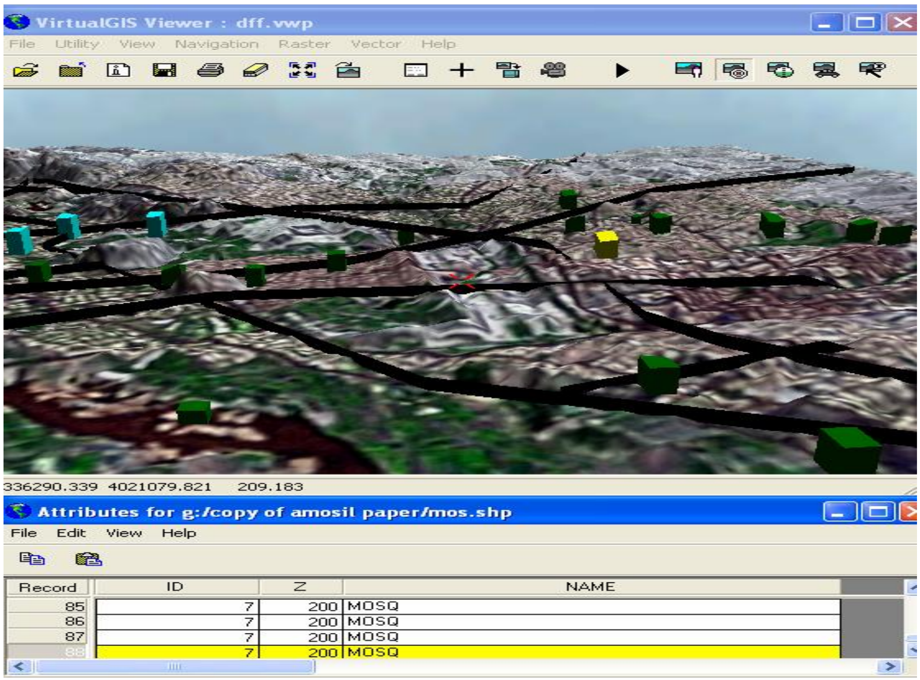

Fig.7c. Vector data represent mosques, network of road and others have been draped over the DEM.

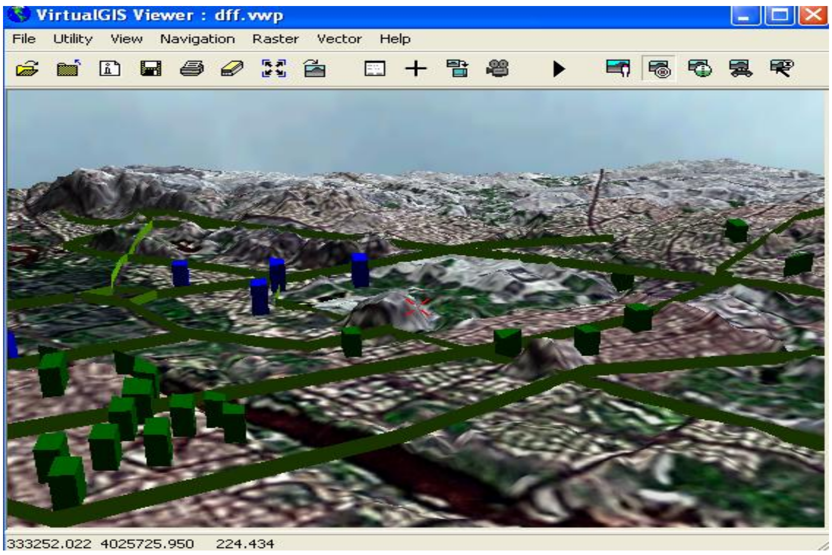

Fig.7d. 3D View of the city of Mosul vector data represent network of road have been draped over the DEM