3D VISUALIZATION OF YTU DAVUTPASA CAMPUS AREA

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ABSTRACT:

Visualization exists from the first known maps to today. Developments in computer science and technologies have resulted in arising new techniques besides maps for visualization of geographic data. Combining technologies such as image processing, computer graphics, animation, simulation, multimedia, and virtual reality, computers can help us present information in a new way so that patterns can be found, greater understanding can be developed, and problems can be solved. Therefore, maps have new missions. Nowadays maps are not only communication means but also visual thinking means for the users. New techniques mentioned above for visualization of geographic information have begun to use commonly in cartography and GIS. These enable us more comprehensively understand our living world. Scientific visualization supports visualization processes. It is using of the computer technology for creating visual supplies to make thinking and problem solving easy. In this paper, we present a case study for 3D visualization of YTU's new campus area. First, geographic and cartographic visualization techniques are shortly given. Then, some applications are given, implemented in MapInfo Vertical Mapper and Autodesk 3D Studio VIZ. YTU Davutpasa Campus is in a big and sloping area, in which there is only a faculty building. There are many construction works in this area. Construction plans include making new roads and new buildings. University needs 3D visual geo-products of the campus for better planning, fast and economic working and easy campus management. In case study, YTU Davutpasa Campus is first 3D visualized in Vertical Mapper by grid method, using the points (x,y,z) derived from large scale topographic map of the campus. Then, draping process is made using georeferenced map objects with grid data to create 3D perspective views of the area. Same area is later 3D visualized using TINs and animated in 3D Studio VIZ. In conclusion, obtained 3D visual geo-products of the campus area can help university managers and students to better understand and easily explore the area for their activities.

1. INTRODUCTION

Cartography was known as map making art and science until technological developments became in 1990's. In the beginning of the 1990's International Cartographic Association (ICA) defined cartography as visualization, digital or paper presentation, communication, organization and using of geographic information. Meaning and scope of cartography has broadened with technological developments.

Increasingly integrated use of GIS and cartography, maps have gained some new functions. Nowadays maps are not only used as communication tool, but also they motivate the users for the visual thinking.

2. VISUALIZATION

In the dictionaries visualization is defined that create something's image or picture which is in our mind or imagine. It is defined in Oxford English Dictionary as 'the power or process of forming a mental picture or vision of something not actually present to the sight' or, as a noun, 'a picture thus formed'. Visualization refers to process. It is 'series of transformations that convert raw simulation data into a displayable image. Visual presentations refer to the products, namely the pictorial depictions of mental imagery and/or of data in any medium. Visual display refers to transient and easily modifiable visual representation on electronic media, such as CRT screens and LCD displays (Visvalingam, 1994).

There are some theories about visualization. DiBiase, Taylor, MacEachren and Ganter defined to visualization with some perspectives of relation of visualization and scientific visualization. Differences on definitions include effect of developments in computer technologies to visualization process.

Borrowing from the literature of both scientific visualization and exploratory data analysis, DiBiase (1990) proposed a framework for thinking about geographic visualization (GVIS) in the context of scientific research. His framework emphasizes the role of maps in a research sequence. It defines map-based scientific visualization as including all aspects map use in science, from initial data exploration and hypothesis formulation through to the final presentation of results (MacEachren, 1994) (Figure 1).

Taylor (1991) defines visualization as cognition (analysis and applications), communication (new display techniques) and formalism (new computer technologies). MacEachren and Ganter added this definition to private-public concept. Difference in perspectives of Taylor, DiBiase and, MacEacren and Ganter are importance of technology which supports visualization. Taylor explains visualization by emphasizing the developments on computer technology while others are interested in visualization applications.
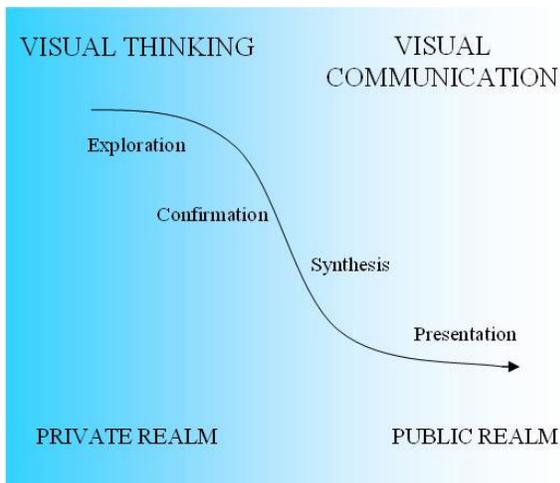
Figure 1 DiBiase's depiction of visualization as tool of scientific research (MacEachren, 1994)

2.1 Cartographic Visualization

Mapping always includes cartographic visualization process. Cartographic visualization's source comes from the static (thematic or topographic) maps. Unless cartographic visualization process mapping process never completes. Also every level of mapping process includes visualization process.

In any of examples just given, the visualization process is guided by saying "*How do I say what to whom*". In 1969 Koeman put forward this proposition. "*How*" refers to cartographic methods and techniques. "*I*" represents the cartographer, "*Say*" deals with the graphics and semantics that represent the spatial data. "*What*" refers to the spatial data and its characteristics, whether they are of a qualitative and quantitative nature. "*Whom*" refers to the map audience and the purpose of the map; a map for scientists requires a different approach than a map on the same topic aimed at children. To the proposition "*How do I say what to whom*" we have to add "*and is it effective?*" "*Effective*" raises some interesting questions. These questions become more complex if we realize that we do not even know the initial aim of the visualization in the circumstances (Kraak, 1998).

Together with the developments in computer technology cartographic visualization gained new functions by means of scientific visualization. Scientific visualization is defined as using computer technologies for creating visual presentations aiming at easier thinking and problem solving. From the cartographic perspective, the aim of the scientific visualization is developing the hypothesis and opinions about geographic information for helping the researcher.
When the spatial data include a z-value they would be classified without doubt as three-dimensional. In the prototype's database the terrain is represented in x, y z coordinates, so they are three-dimensional. The visualization by the prototype, whether on screen or paper, is perceptually three dimensional as well, because the images contain stimuli that make the user perceive their contents as three dimensional. Some would argue this, however, because the third dimension is not tangible. As a result these images are often described as two and a half dimensional only (Kraak, 1994).

Technologic development allows interactive map making possibilities. All two-dimensional, two and a half dimensional and three-dimensional maps can create on the screen by visualization softwares. Also the screen maps can be animate with animation methods.

2.1.1 Animation: Easiest definition of animation is presentation of the photos, which related each others, as a slide show in the same time series. This action of the photos gives their content a movement. The first cartoons created with this method.

A cartographic animation is the depiction of change over time. The division in temporal and non-temporal animations is often taken for granted. The temporal animation is used to display time in a temporal sequence. The non-temporal animation is used to explain spatial relations by presenting individual map images in a sequence, that is not related the time (Kraak, 1999).

3. CASE STUDY

Yildiz Technical University (YTU) has a plan that Besiktas Campus moves to bigger Davutpasa Campus. This new campus has only one building. So university needs some buildings to complete the plan. For economic and proper campus planning university needs 3d map of the campus, which we motivated for this case study.

In this study we first needed geospatial data of the campus area. That handled with the geodetic surveying method by students in one of the courses of our department. Campus area divided into eight zones. One lecturer and one research assistant managed sixteen students for surveying in every zone. After the geodetic surveying the data transferred to computer for cartographic drawing by students. After the controls, all data were combined and 2D campus map was created. That drawing includes roads, buildings, he, etc. Later that map imported into AutoCAD Land Development Desktop software. Contours were created by this program. And then the map which includes contours imported into MapInfo Vertical Mapper and 3D Studio VIZ softwares. The Campus area is visualized in Vertical Mapper by grid method, using the points (x,y,z) derived from that map.

In Vertical Mapper for making 3D map, points are necessary with x,y,z coordinates. If data includes 3D lines and 3D polylines, don't includes 3D nodes, program converts 3D lines and 3D polylines to 3D nodes by grid method and polt-to-poit process. First the dxf file which includes contours is opened (Figure 2). After that contours converted to points by poly-to-point command. After that points converted to 3D drape file by grid manager. Then 3D topographic surface was created to using the drape file. This program allows user to see the different perspective views of the terrain and zooming options (Figure 3). Also it allows user to scaling the map along the z-axis. This is important for the easily understanding 3D topographic structure. Otherwise program doesn't allow 3D visualization of buildings, trees and other natural and human made objects. Also there are no animation possibilities in Vertical Mapper.
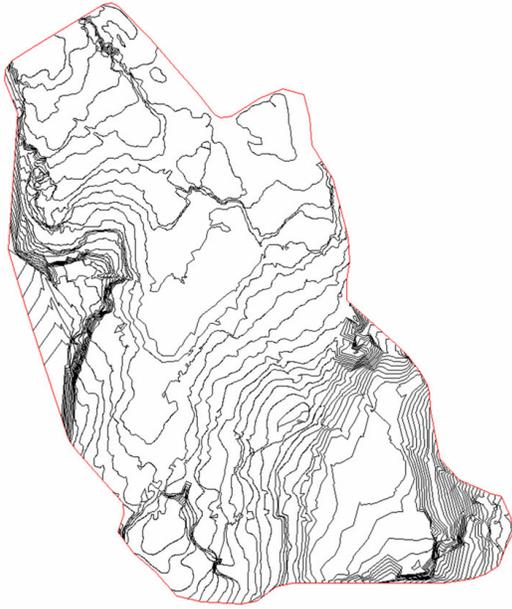
Figure 2 Contours in MapInfo Professional
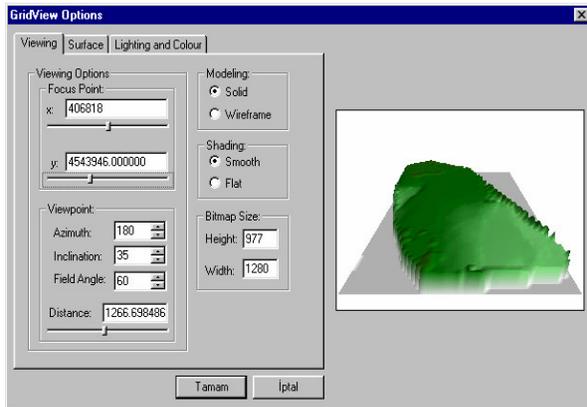
Figure 3 3D grid view options in Vertical Mapper

The second part of case study campus area visualized by 3D StudioVIZ. Firstly contours are imported to the program. Program automatically creates covered terrain structure by using the contours. There are three different cover choices in the program. These are "graded surface", "graded solid", "layered solid". I prefer to use "graded solid". Because topographic structure smoothly appears and surface cover is built from TIN. Lighting of the area is done with "sunlight" option.

Program has two different appearances. One of this is "smooth+highlights" options. This option allows to user to see smoothing view of the project. Other view is wireframe which allows to user to see uncovered objects which has lines.

There are a few buildings in the campus. They are Faculty of Arts and Sciences building, Otag-i Humayun (an old and historical building which needs to restore), gymnastic center and dining hall. The entire buildings boundaries were redrawn with line commute by 3D Studio VIZ. Then they were extruded

(Figure 4 and Figure 5). So they were created in 3rd dimension. Faculty of Arts and Sciences building's windows and doors were created and visualized. Then roads middle axis was created with line commute and extruded 3rd dimension. Entire buildings were covered and painted their real color. The natural varieties determined and approximately similar 3D drawing type of trees which were available in the campus found from internet. This tree type was proper but there was complicate. So they use the memory so hard. For the easy studying and drawing with the program we should have a high capacity (ram, processor etc.) computer. The computer which I study is an average capacity so I hard to study especially putting the trees. I try to put all the trees in the area but this was impossible with my computer. So I firstly put the big and old trees which surveyed. Then other trees put after eliminating. This elimination allows me to easily studying with the computer. Then boundary walls were created. Back to the boundary walls another high walls created for the back round. And the back round walls covered with the sky photos.
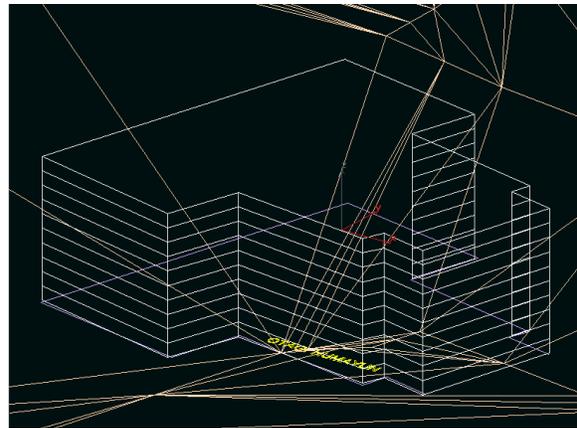
Figure 4 An extruded building by 3D Studio VIZ (fireframe view)
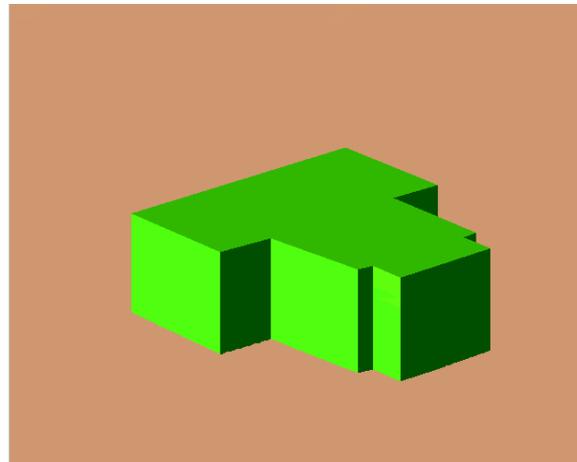
Figure 5 An extruded building by 3D Studio VIZ (smooth+highlights view)

The second part of the case study includes animation. I decided to make two different animation of the area. One of them is animation which goes over the area the other is an animation which goes along the roads. First, one animation spline which

goes over the campus area was created. Then a camera crated and camera's target linked to the spline. Time settings were done with the time configuration commute. Movie time range was determined 1:37 minutes for flying animation (Figure 6). And frame rate was determined 24 fps for the smooth view. Then camera angles were set for the animation. Creating the movie was created with the "make preview". This process took approximately 20 hours. If you study with a computer which has high capacity processor and rem this process can be complete in lesser time. For the second animation there is a 3D car drawing downloaded from internet (www.3dcafe.com). The car was not necessary for the second animation. But it is better for emphasizing the roads. The second animation's aim is visualizing the surface of the area like walking on the surface. There is a line was drown for the linking camera' target. At the same time the car was brought the road. And a camera was created near the car. The car and camera's target linked to road's middle axis. Movie time range was determined 1:30 minutes (Figure 7). And movie created after 6 hours program processing.

Figure 6 A view of the first animation

Figure 7 A view of the second animation

3. CONCLUSION

Nowadays there are various visualization techniques. So there are lots of softwares which can be used for the visualization process. Which is the most proper software. for the cartographic visualization? This choice is important for the cartographers. For this reason I did this case study. I studied with two different software and I saw that both of them have some advantages and disadvantages.

3D Studio VIZ software has good characteristics for 3D visualization and animation. It has enough options for movie making. You can create a movie all the perspectives and every places of the project. You can create different movies in different time segments. Its material box, render options and surface covering options make it useful for 3D visualization study of a campus. It includes three different surface covering types. But it don't has cartographic presentation objects. For such a project, a PC with high capacity is important with respect to productivity.

Vertical Mapper has lots of cartographic options. For example it has Grid Manager options for visualizing height information and it has also different interpolation and modelling methods. Its 3D modelling options has good properties. For instance it has scaling along the z-axis on the Grid View options window. And user can zoom and rotate the model. Then he or she can render any of the perspective of the model. But there is no movie making options. And only terrain can be visualized. There are no options for creating buildings, trees and other natural varieties. A PC with average capacity is enough for study with this software.

In conclusion 3D visualization processes have to include some cartographic methods. Cartograpy discipline should determine cartographic rules for visualization softwares. The proper softwares should be created after the determining the rules.

REFERENCES

Kraak, M.J., 1998. Interactive Modelling Environment for Three-dimensional Maps: Functionally and Interface Issues. In: *Visualization in Modern Cartography*, Eds: MacEachren, A.M., Taylor, D.R.F., Pergamon, pp. 269-285.

Kraak, M.J., 1998. The Cartographic Visualization Process: From Presentation to Exploration. *The Cartographic Journal*, Vol.35, No.1, pp. 11-15.

Kraak, M.J., 1999. Cartography and the Use of Animation. In: *Multimedia Cartography*, Eds: Cartwright, W., Peterson, M.P., Gartner, G., Springer, Germany, pp. 173-180.

MacEachren, A.M., 1994. Visualization in Modern Cartography: Setting the Agenda. In: *Visualization in Modern Cartography*, Eds: MacEachren, A.M., Taylor, D.R.F., Pergamon, pp. 1-12.

Visvalingam, M., 1994. Visualization in GIS, Cartography and ViSC. In: *Visualization in Geographic Information Systems*, Eds: Unwin, D.J., Hearnshaw, H.M., John Wiley and Sons Ltd., pp. 19-25.