COMPUTER VISUALIZATIONS IN PLANNING

Computer Techniques for Visualization of Development Scenarios for Historically Important Landscapes and Urban Spaces: The Case of Nablus

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Abstract. A wide range of visualizations have been developed and implemented as tools for urban simulations and visual impact assessment. These include: plans, diagrams, elevations, perspective sketches, renderings, modified photographs (photo renderings and photomontages), slide projections, scale models, movies, videotapes and computer graphics. In the last decade, graphical computer applications have proven to be an increasingly supportive tool in visualization and manipulation of graphical material. This study presents the state of the art of computer visualization in planning. More specifically, the use of web-based computerized visualizations for landscape visual simulation, with the aim to develop a system of visualization techniques as an aid to communicating planning and design scenarios for historically important landscapes and urban places, with particular attention to the city of Nablus in Palestine. This has led to the evaluation of possibilities and potentials of computer use in this field, and to the definition of the visual problems and challenges of the city of Nablus. This study will argue what extra one can draw from computerized visualizations, what is likely to be its impact on future planning and design research, and what this visualization experience really means for historical important locations as in Nablus. The study demonstrates that computerized visualizations can be a powerful tool in representing a cityscape in three-dimensions from different angels. Visualizations will allow better understanding of the components of the city, its landscapes, city features and the process of change. In this way it may provide new and better platforms for public participation in planning.

1. Introduction

In city and landscape planning and design there is in many cases a need for the ability to mix reality and virtuality. Or in other words; to understand the visual effects or impact from a specific development or project implemented in a local area you must try to imagine what the future physical elements, such as buildings, roads or trees will look like and how they will integrate in the area. This task can be done in many ways. Planners and designers used many classic analog visualizations tools for the representation of ideas. For ages planners and designers used the ability to create perspective drawings and paintings where reality is mixed with planned objects. An example illustrating the use of **perspective** sketches is the work conducted by Emmelin and Brueswitz (1991). They used hand made drawings sketches in order to view possible changes in the Swedish landscape (See Figure 1).

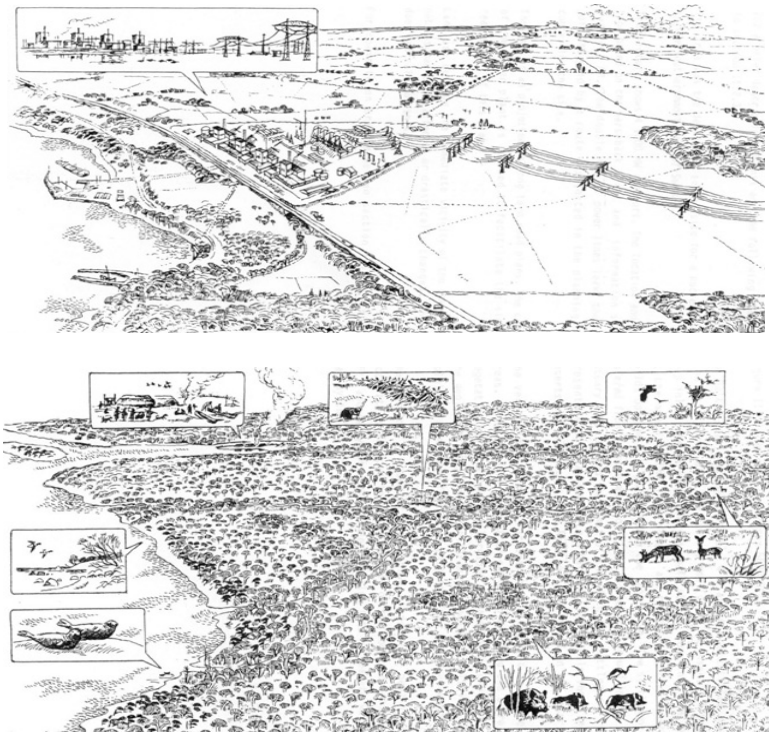


Figure 1. Emmelin and Brueswitz (1991), showing possible changes in the Swedish landscape through sketches.

Among landscape architects Repton (1803) can be seen as an early pioneer in visualization. In his Red Books Humphry Repton concentrates on the representation of proposed changes in the landscape in **perspective view**

comparing the existing situation with his proposal. Two slides as Repton called them, were hinged at the bottom so that the slide depicting the proposed improvement could be flipped up to cover only those parts of the slide depicting the existing landscape that were to be changed (see Figure 2). Repton suggested this provided a more effective way than maps or plans to help his clients visualize the effects of proposed changes.

Figure2. Humphry Repton slides (1803), showing the landscape before and after the development.

Another option is to build **physical models**, which illustrates the terrain and the existing buildings together with the developments suggested in the project. A third option is to make **a photomontage,** by attaching the proposed scheme onto a real site photograph and give the impression of a completed situation within it's actual context. There is at least one big disadvantage with these conventional methods. It is almost impossible to change the plan without creating a new illustration or a new physical model. The flexibility you need when the conditions in the plan or the subject of visualization are changed is not there. Furthermore the ability to show visualizations of more abstract geographic information in perspective view is not there either. This may not be a major problem for the professional designers and planners, because they have learned and trained to interpret the planning documents. However, it is certainly a very tangible problem for the politicians and the common citizens in the area of interest. They have to trust their own imagination or the few illustrations and models that are made from the information given in the planning documents. Members of the

general public who are not so familiar with the habit of planning documents may not fully comprehend the developments that they represent, and may find it difficult to comprehend how new developments would 'fit' into the environment. Stanley King and his co-authors (King et al., 1989) suggest that visualization is the key to effective public participation because it is the only common language to which all participants technical and non-technical can relate "*Visualization provides a focus for a community's discussion of design ideas; it guides community members through the design process, it raises their design awareness and facilitates better communication*".

Therefore, there is a great need for new and better ways to visualize the effects of proposed developments, especially because the citizens of an area have the right to know how the implementation of this plan will affect the area they live in both visually and environmentally. In this way, visualizations will secure the opinion count of community groups, and it will work as instrument to communicate design and planning proposals between planners and the public.

2. The Case of Nablus

In a topic of a recent PhD-study carried out at Department of Landscape Architecture and Spatial Planning at NLH – Norway by Hassan (2002), Nablus is identified as an important geographical, historical and cultural city. Nablus lies in a valley between two mountains, Mount Ebal (940 meter) above sea level and mount Gerzim (870 meter) above sea level on the south. Most important is the fact that different planning strategies have determined the Nablus image and form in the last century. The developments that occurred in the last period helped the city growth, but there were no clear regulation and orientation to control this growth, which lead to several problems concerning the city's visual appearance from both architectural and planning views. This development now leads to the destruction of the image of the two main hillsides of mounts Ebal and Gerzim. The result is a vast deterioration of the city landscape and environment. There is little respect for planning considerations that care for the aesthetic values of such an ancient city (See Figure 3). Based mainly on its distinctive physical, functional characteristics, and the development trends, the city of Nablus may considered to be composed of three main parts: 1) The Inner city - with the Old Town part: a district rich of historical evidence. 2) Mount Ebal and Gerzim hillsides (see Figure 4): two district areas, with fast city development activities. 3) The Eastern and Western plains: two districts, originally kept for agricultural and industrial uses, later they became place for refugee camps and new housing development projects. On the background of

Nablus' geographical and historical importance, and as the city continues to expand and more building activities are taking place, the study classifies two main visual challenges regarding the city appearance, which the city might

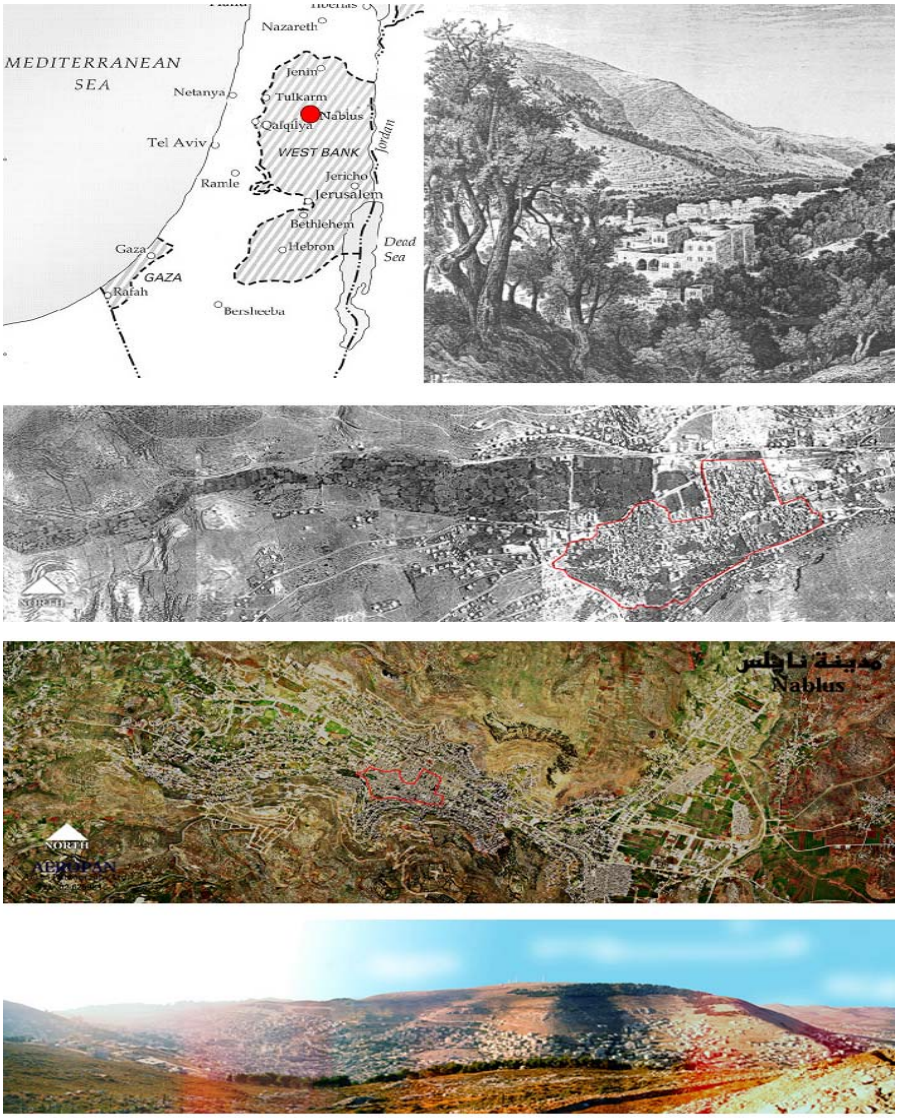


Figure 3. View on Nablus, from left side and down: Map showing location of Nablus; View of Nablus from19th century as seen by Wilson, C.; Arialphoto of Nablus from 1944 with the Old City in the center; Arialphoto of Nablus from 1999 with the Old City in the center; View from Mount Gerzim looking northwest, shows the typographical location of Nablus between two mounts.

face in the future: *The first* is the visual challenges on large city scale. This can be represented by the continuous developments on the hillsides of Mount Ebal and Gerzim, enhanced by the high visibility of the hillside, which represent a unique situation in which changes on the hillsides can be seen from almost any place in the city (See figure 5). *The second* is the visual challenges on district or local scales in the city. This can be experienced in the inner city part, where many open spaces and leftover archaeological sites around the Old Town are threatened by new building activities. This might have an effect on the Old Town and city appearance in general.

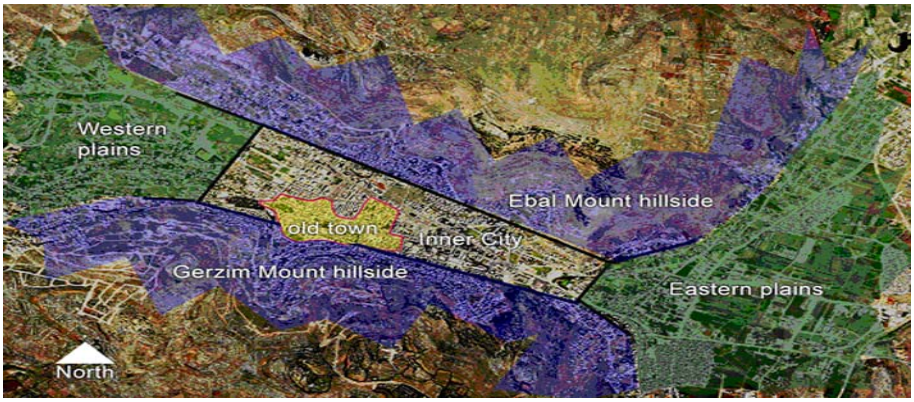


Figure 4. Illustration shows the main three zones that characterized the landscape of Nablus.

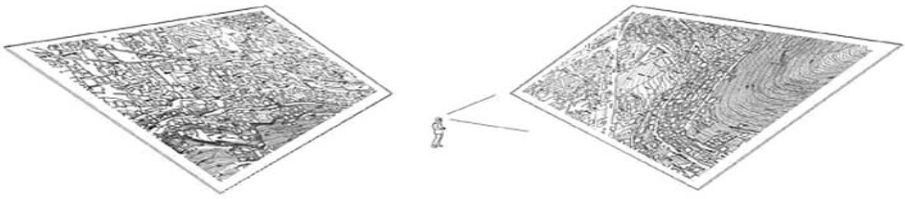


Figure 5. Illustration shows the typical layout of the two main hillsides of Nablus displayed against each other; showing the high visibility of the hillsides.

3. Visualization Techniques and Process for the Case Study Area

The study focuses on the technological aspect of visualization for urban simulation as an innovative tool for interacting with the planning process. Processes and techniques are discussed which all deal with aspects which are relevant for the visualization of the town of Nablus. The focus is not only on the visualization of the urban environments, but also on larger parts of the landscape. Specifically, the evolving modeling techniques for efficiently

creating, visualizing, and managing virtual urban environments. Examples from the field of research and practice are investigated. Further, attempt is made to specify the types of visualization techniques that are applicable for the case of Nablus, which can provide a basis for interpreting the visual impact of new developments on the city landscape (See Table 1). As a result it was identified that the latest developments in web-based computer visualizations will provide opportunities to use digital techniques to view various development scenarios, which might encourage the public to interact with design proposals.

Table 1. shows the differences and different uses of different types of computerized visualizations.

Visualizations type		Pros	Cons
Pre-defined visualizations *(Video films & computer animations)*	DYNAMIC VISUALIZATIONS	- Gives an overview of the proposed conditions the form of animated film that can later be played back. - The visual quality of such visualization is very realistic, because of the pre-film editing possibilities of picture and sound. - Such visualizations can be distributed on video tapes or Compact Disks.	- Since the camera movement and the recording of the film are pre-determined, viewers are left passively to watch the film as they watch ordinary TV with no control over the contents. Similar to static visualization, they cannot change their viewpoints, for example, to see other parts of the model. - This technique could be misused to avoid some areas from not to be filmed, where there may be severe impacts on the overall environments. - Any changes to the proposed project, such as the shapes and textures of the objects, or its location changes, will result in the remodeling and re-filming to reflect the changes.

Interactive(VR) visualizations *(Geometric Model VR visualizations: VRML's)* + *(Photo-Realistic Media VR visualizations: QTVR's)*	DYNAMIC VISUALIZATIONS	- Facilitates freedom of movement within the model, and the simulation of movement at ground level minimizes the dangers and misconceptions of bird's eye view perspectives, that scale models and computer-generated images very often suffer from. - Presentation and comparison of alternative schemes is simplified and building elements can be selected and investigated in greater detail if needed. - The ability to interactively visualize projects in context and the limited degree of visual manipulation the proposing team can enforce. - The design and evaluation circle can be significantly shortened since digital information is much more easily manipulated, edited and presented. - It facilitates the illustration of changes whilst minimizing the cognitive load to the recipient. - It can be argued that VR enables more substantial public participation, making information more accessible and comprehensible.	- A photo realistic visualization is difficult and labor intensive for some interactive visualizations. - Visualizing 3D interactive models of huge landscapes or cities needs advanced computing equipment,. - Viewing some types of 3D interactive visualizations need some special computing equipment like: 3D theaters or CAVE's, which are very expensive to install. - No standard system for constructing virtual models. - Interactive visualizations that are web-based, suffer at the time being from the restrictions of the Internet Bandwidth (the speed of transferring files through the Internet).
Computer based edit-images		- Their main advantage is that they show the development within the real landscape and from known viewpoints. - Advantages in speed and cost. - Computerized static simulations have the advantage that they can be performed in a photo realistic way.	- The creator of computer visualizations needs to have knowledge of various systems.

A pilot project was carried out to test some of the defined goals and objectives. The objective of this pilot project is to identify the opportunities

and constraints of computerized visualizations for the intention to develop a visualization system that is able to support planners and designers in planning and communicating proposed developments with the public in the urban landscape of Nablus. This was done by showing examples of the visual effect of future proposed development on the appearance of city landscape. The visualization system is developed within the limitation of PC environments, which uses the web as main visualizations engine. A number of visualization forms and tools are used in the visualization system (See Figure 6), more specifically: 1) Visualization of proposed development in the form of static and dynamic simulation. This gives more depth to the visual impact of developments in the appearance of the city landscape. 2) Visualization of the existing environment. This to give a true impression of the existing surroundings before developments are taking place. 3) Visualizations of historical evidences of previous civilizations, which will shed light on the historical importance of the area. To enable the possibility to store, analyze and retrieve related data, a GIS system is suggested in such a visualization system.

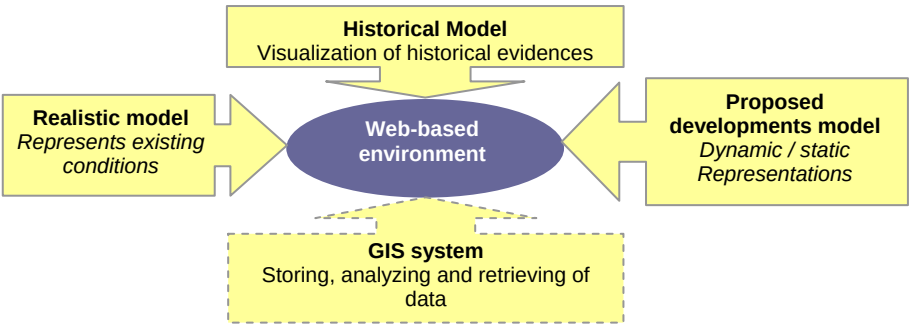


Figure 6. Basic concept of the visualization system.

The pilot project was planned and developed in three main stages (See Figure 7), starting with the definition of project scenarios and the visual analysis of selected project proposals, followed by the construction of the required visualizations for the simulation of new conditions, and then the representation of the findings and the creation of the visualization model.

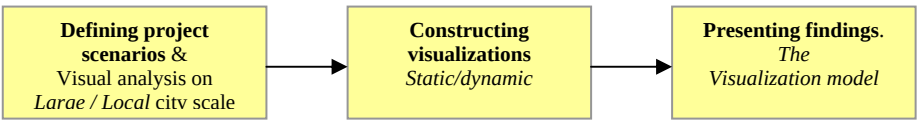


Figure 7. Development stages of the pilot project

3.1 ALLOCATING PROJECT SCENARIOS

In the attempt to provide examples that show how to operate visual simulations by means of computer visualization techniques, a decision was made to choose project locations and scenarios that might have a clear impact on the visual appearance of the city landscape of Nablus. Two project examples were chosen to represent the **large** city scale visual challenges. The developments on the *hillsides of Mount Ebal*, and the construction of a *bridge* connecting the two hillsides of Mount Ebal and Mount Gerzim. (See Figure 8)

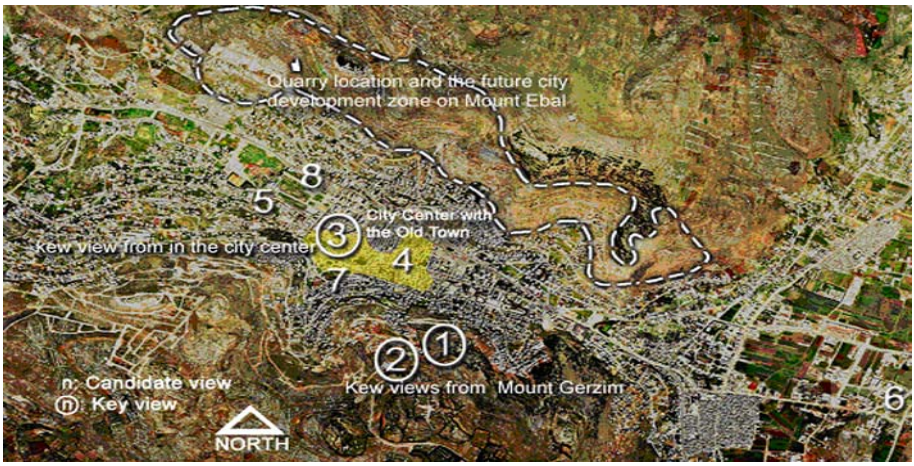


Figure 8a. Large scale project example: Ebal mount hillside development with main key views.

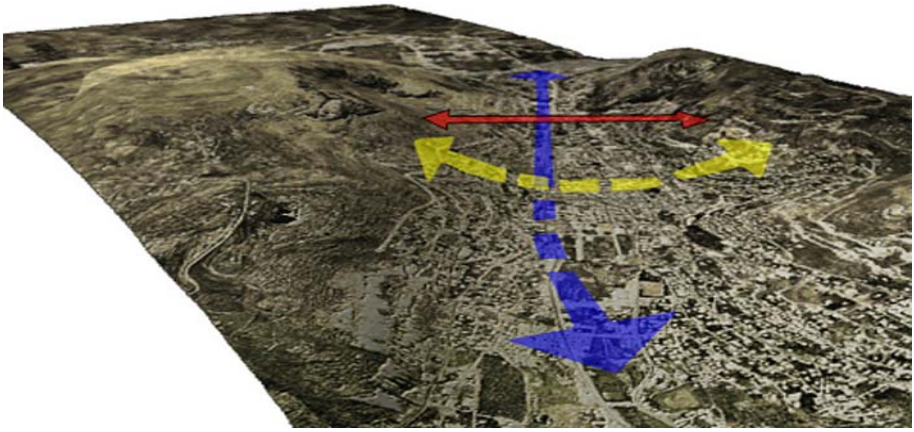


Figure 8b. Large scale example: Bridge project connecting the hillsides of Mount Ebal and Mount Gerzim.

On the **local** city scale, the development of the main city square was chosen as an example (See Figure 9). In addition, and as preparation for the construction of the required visualizations, a site analysis study of the project surroundings was conducted. The resulting analyses provided basic visual studies and representative views.

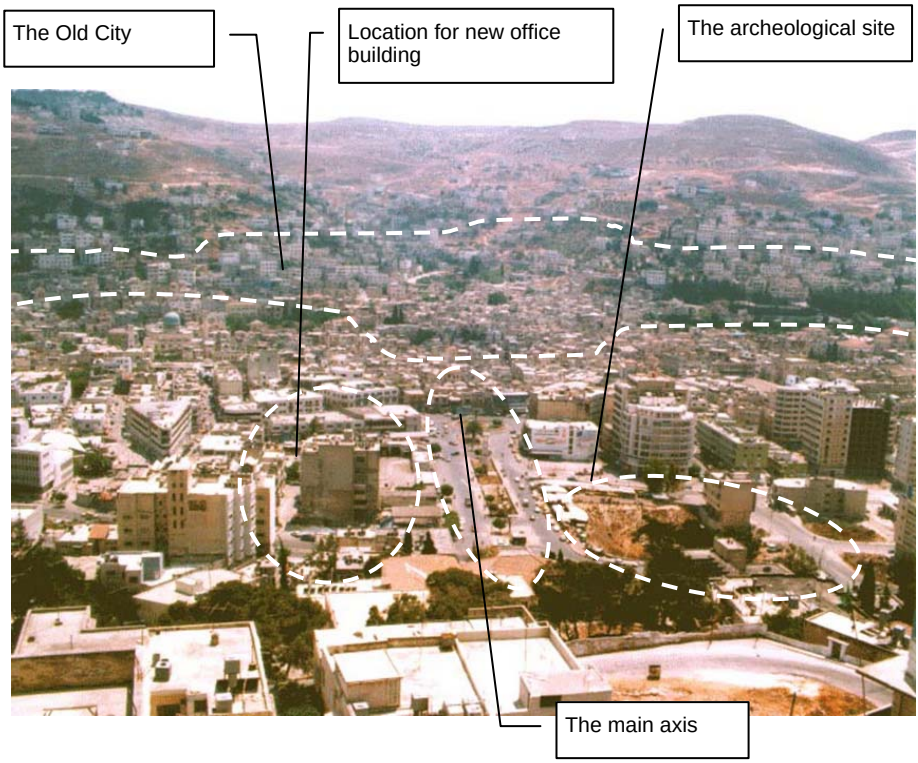
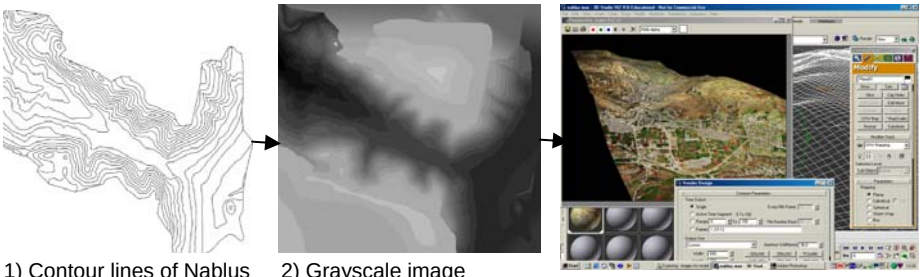


Figure 9. Local scale project example: the main square at the city center.

3.2 CONSTRUCTION OF VISUALIZATIONS

Two main forms of visualizations techniques are used to construct the visual simulations: static & dynamic visualizations. Static visualizations are represented by digital photomontage simulations of the various development scenarios. Dynamic visualizations are represented by the 3D VRML virtual models of the developments proposals with the historical 3d model, and the QTVR panoramic views for showing the project surrounding. The end product is a virtual model (VRML model) of the site, which could be navigated and distributed over the Internet. The visualizations were constructed according to the criteria that all models must be manageable for most PC platforms. In order to model the landscape form, a method to generate a 3D digital terrain model was identified (See Figure 10). Contour

line map was used as a basis to generate a grayscale image that represents the topography of the landscape; this image is then used in a CAD system such as 3Dstudio VIZ to give the height and shape of a GRID terrain model. An aerial photo of the site is then draped over the terrain model. Through this method one is able to generate a digital terrain model of the landscape of the city with less polygon counts. This is of great importance when transferring 3D model to a VRML format for web-based visualizations. To achieve a good performance during the process of downloading and navigating of the virtual model on the web, a decision was made to use simple abstract features with lowest amount of polygons, and also texture bitmaps that do not need much time of computer calculation (See Figure 11).



1) Contour lines of Nablus Prepared in AutoCAD

2) Grayscale image represent the height-map.

3) 3D terrain model is generated in 3Dstudio-VIS

Figure 10. Procedure used to create terrain model for the city landscape Nablus using grayscale image.

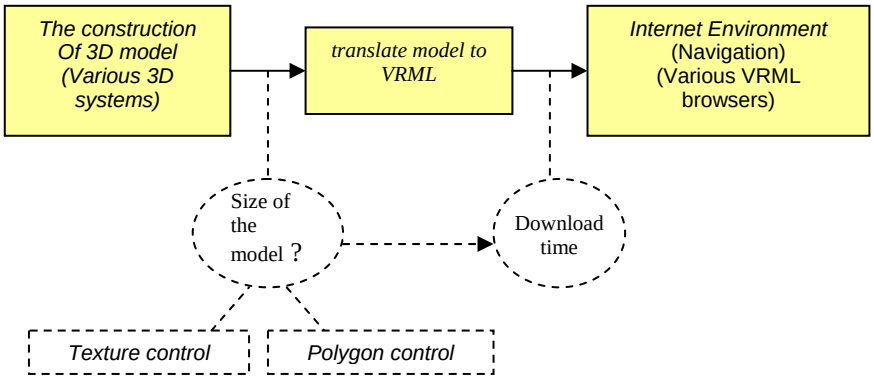


Figure 11. Process and steps to create the virtual model

Various modeling technique are used to construct the 3D models for the Ebal hillsides developments 3D model, the construction of 3D historical city (See Figure 12), and the construction of main square model.

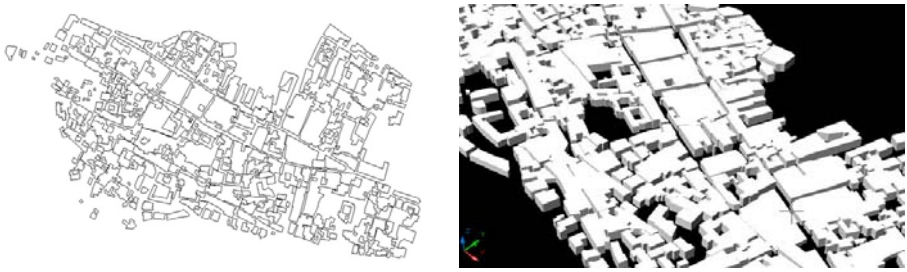


Figure 12. 3D model of the old city part of Nablus.

World Construction Set (WCS) by 3DNature was used to produce 3D renderings of the city landscape. WCS was found extremely powerful for landscape terrain renderings, designed specifically for creating landscape photo realistic images. The system allows the complete control over every aspect of the look of the land. With its 3D texture facilities, it is a pioneer system among other system commercially available. A resulting perspective views is shown in Figure 13. A drawback of WCS (at the time the study was conducted) is not having the mechanism within the system it to produce or to export VRML files. This problem is been solved in 2004 by the release of Scene Express for realtime navigation by 3DNature.

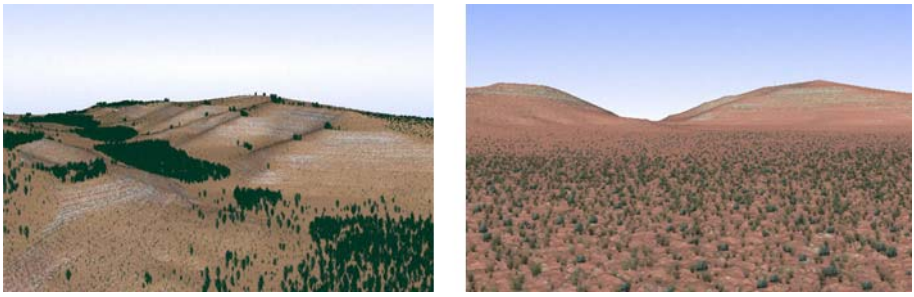


Figure 13. Two computer images of the landscape of Nablus made by World Construction Set.

3.3 THE VISUALIZATION MODEL

The visualization model as part of the visualization system demonstrate how various computerized visualizations can be combined together to form a model whereby city planners, designers, and community groups can get the possibility to visualize, evaluate and communicate possible future conditions and new developments in the urban environment of Nablus (See Figure 14).

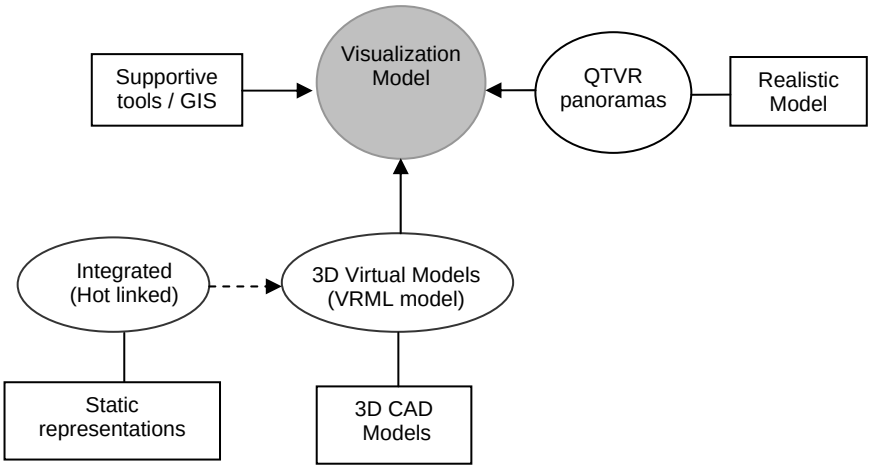


Figure 14. Components of the visualization model

The focus is on constructing a model for viewing and interacting with 2D-static and interactive 3D-dynamic visualizations, with a comfortable graphical user interface that will allow an expert and a layman to find their way and to understand the data easily. The interface and visualization software runs on the entire line of desktop platforms, allowing extensive use of real-time navigation. The visualization model interface uses the hyper-text markup language (HTML) Windows standard, and includes a well-defined set of functions that most users find sufficient for loading and viewing models and visualizations without additional programming effort (See Figures 15, 16 and 17).

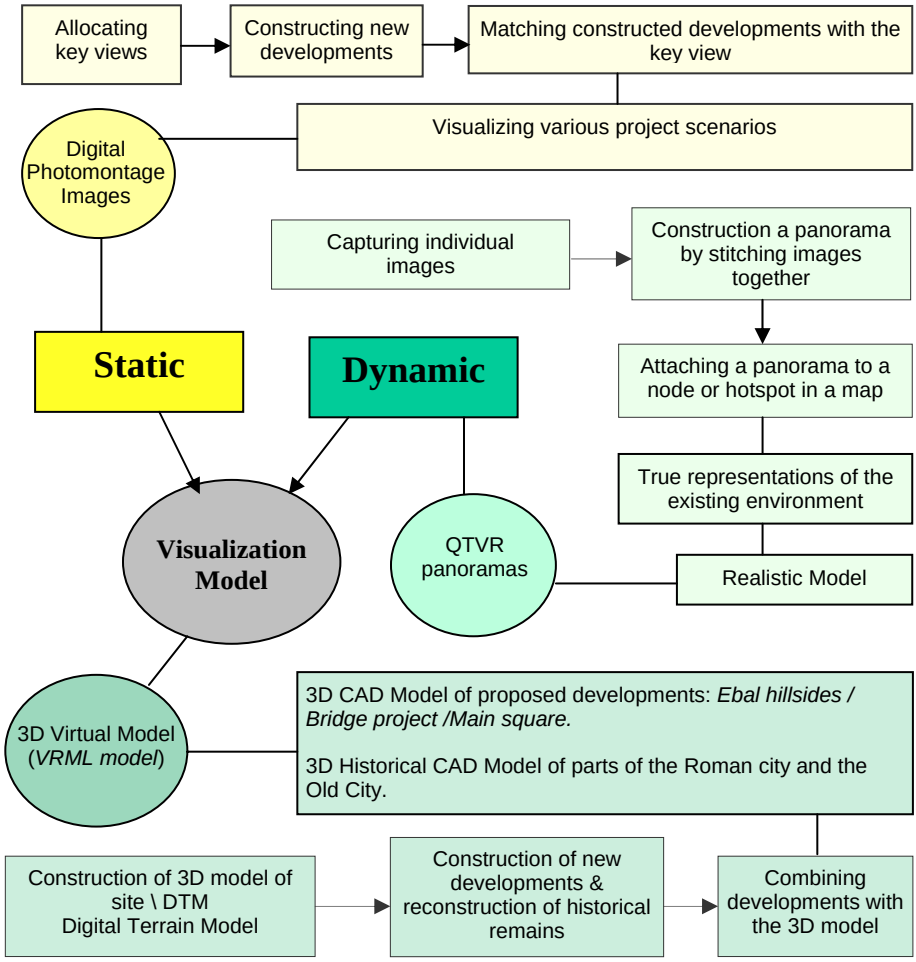


Figure 15. Detailed structure of the visualization system.

Figure 16. Some Images from the visualization model showing the visual experience of development projects at the city landscape Nablus.

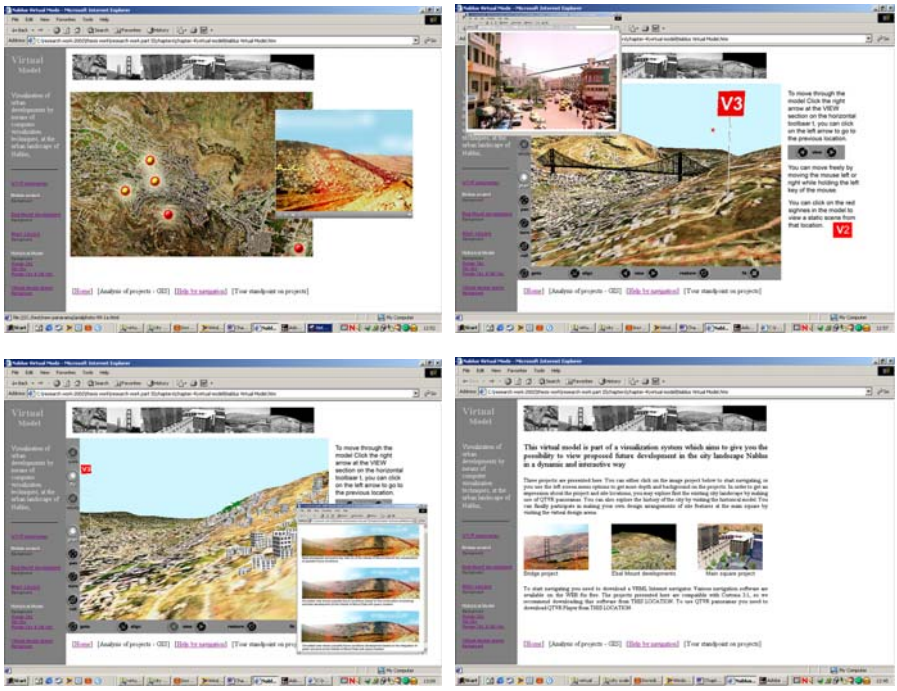


Figure 17. Screenshots of the visualization model.

4. Conclusion

The system highlighted the visual challenges, which the city of Nablus is going to face in the near future, by quickly exploring development proposals and alternative design solutions. The interactivity, flexibility, photo-realism, and adaptability of the visualization forms used, make this technology an effective tool for interactive design in the complicated process of the city planning. The system indicated the potential of building virtual reality environments with very low cost, by using relatively cheap PC hardware and commercially available software. The system has verified that real time web-based visualizations in the form this study used it are suffering from many restrictions. More specifically the following restrictions were identified:

- *The limitations of VRML* for large models and urban scale models in particular are very substantial. Current state of the art for VRML techniques demonstrates a focus on small-scale projects.

- *3D CAD modeling* of existing environment is still made manually. Much of the time needed to model virtual environments is spent on this stage by collecting data and constructing the 3D model.

With respect to the case study, the study has shown that the future shape of the urban landscape of Nablus will be determined by the way planning strategies and future development scenarios will take the historical, geographical and cultural weight of the city into consideration. Because of the high visibility and dominant character of the two main hillsides of Mount Ebal and Mount Gerzim, Nablus proves to be a case where development proposals within the city landscape requires more than the average level of planning.

As for the case of Nablus and the use of visualizations, the study concludes that this visualization experience brought together many integrated aspects: the historical evaluation of the city, the future image and appearance of the city, the cultural identity, and the technological innovation.

References

Emmelin, L. and Brusewitz, G.: 1990, *Painting the Future: Visual Impact Analysis of Changes in the Swedish Landscape*, University of Trondheim, Norway.

Hassan, R.: 2002, Computer Visualizations in Planning. Computer techniques for visualization of development scenarios for historically important landscapes and urban spaces, *Doctoral Thesis*, Department of land use and landscape planning, Agricultural University of Norway.

King, S., Merinda, C., Latimer, B., and Ferrari, D.: 1989, *Co-Design: A Process of Design Participation*, Van Nostrand Reinhold, New York.

Repton, H., 1803: *Observation on the Theory and Practice of Landscape Gardening*, Taylor London; Pahaidon 1980, Oxford.