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Cairo the Combat Land.
The City Layered

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The expansion of Cairo's informal areas is due not only to rising poverty levels, but has been fostered by the permutations of series of deliberate policy choices and market dynamics which were not properly dealt with. The idea came from the dense fabric of our cities, the community of layers. The 4D space-time modeling as a manifold in space of large number of measurements provides a real possibility of constructing a way for large-scale cities of a four-dimensional physical space-time for decoding all cities intersected harms. Focusing on planning to produce space using the temporal relations to spatial transitions will describe the impact of changing spatial structures on temporal patterns. The research will discuss the proposed method from all of its fringes and the new gesture values which will be shaped for city formation, both hypothetical and initial applicable model done in practice to serve in upgrading or rehabilitation of informal settlements and weave the city patches.

Keywords: Informal housing, City patches, Culture layers, Deconstruction, Space-time.

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Introduction

The needs for 3D city models are growing and expanding actively in various fields includes urban planning and design, architecture, environmental visualization and many more. The efficient generations of the 3D city models are improving the practice of urban environmental planning and design. For example, planning authorities will be able to illustrate explicit photo-textured information of what the city environment will look like after a insinuated change. Photo-textured and three-dimensional models enable easy understanding. It is relatively easy to layer abstract phenomena over a detailed model. User would be able to distinguish particular elements, spatial position, scale, and to relate plan details and other information within the area under reconnaissance. The computational power of this technology to transform and instantly compare alternative representations provides decision-makers with unprecedented flexibility. When and if visualization tools and good data are widely available, one will be able to propose changes to a city without a dialogue that includes a systematic investigation of the visual implications of a design (Eran S., et al 2009).

There are various terminologies used for 3D city models such as “Virtual City”, “Cyber town”, “Cyber city”, or “Digital City”. 3D city models are basically a computerized or digital model of a city contains the graphic representation of buildings and other objects in 2.5 or 3D. The term 2.5D is used for describing models where there is only one unique Z-value (elevation value) defined for each pair of XY-coordinates (M. Sinning et al, 1996). 2.5D ("two-and-a-half-dimensional"), 3/4 perspective and pseudo-3D are terms, mainly in the video game industry, used to describe either: 2D graphical projections and techniques which cause a series of images or scenes to fake or appear to be three-dimensional (3D) when in fact they are not, or gameplay in an otherwise three-dimensional video game that is restricted to a two-dimensional plane.

However, some type of objects like CAD models or solid models can be represented as 3-D. The most important characteristic of 3D city models are the possibility to navigate through the model by walking, flying and examining (Bourdakis, V.1997). Walking means moving on the model surface, flying has three dimensional freedom of movement and examination is a view where the entire model is visible in the view port and the user is free to rotate the object in three dimensions. 2.5D visualization and 3D visualization have static predefined viewpoint and users only move the object rather than engage into the environment. The highest form of visualization is using virtual reality (VR) technology. VR offers new technique for visualizing 3D city model. This is the reason why virtual 3D city model term is used instead of just a 3D city model. By using the VR technology, navigating through the model so easy. The environment where this model consists is known as virtual environment (VE). A virtual 3D city model can be viewed on a computer screen, projected on a large screen or with head mounted displays (HMDs).

Virtual Reality (VR) is an interactive and immersive real time visualization technology that offers people the opportunity of visualizing, interacting with and manipulating complex data in a real-time 3D environment by means of the most advanced computer technology. VR is a cutting-edge technology and the interdisciplinary communication tool of the future. It allows users to evaluate planning results in real time and to compare alternative concepts. By using these technology decision-making processes are shortened, information and appreciation are improved and the identification with the city increases. VR applications include basically the following components: A three-dimensional visual database: the Virtual City Model, real-time software package to interact with, visualize and practically use the database, and an appropriate virtual reality hardware system (input devices, computer technology and image representation systems. (Bendinger, J. 2008).

Figure 1. 3D City Visualization
Figure 2. City generator.
Source: http://forums.introversion.co.uk/introversion/viewtopic.php?t=1132

Virtual City Models are created by means of state-of-the-art technology. Basic digital geographic data, relevant information obtained from the city's Geographic Information Systems and three dimensional architecture models are used to establish a geo-referenced three-dimensional municipal database: land surveying geographical data (digital cadastral map), digital terrain models (DTM), digital surface model (DSM), digital aerial imagery, orthophotography, site plan, floor plan, cross sections, views, location photographs, model photographs, material and surface description (Bendinger, J. 2008).
4D expression describes the real-time software packages which allow viewers to interact the 3D model with the real time data. The software controls both interaction devices and output systems. Input data is computed in real time to produce at least 20 images per second. As Virtual City Models are of high complexity, they contain extremely large volumes of data and could be presented in the past only on high-performance graphics computers. Now, the software solution HYVE (Hybrid Virtual Environment) allows users to view the models on PCs, too. The resulting cost benefit is considerable: large data volumes are processed in less time, and costly hardware systems are no longer needed (Bendinger, J. 2008).
VCM offers planners, architects and stakeholders an effectual tool for plan regulatory and decisions making purposes. Incorporating urban development revelations and different planning alternatives, act out various stages of completion and viewing schemes in infrastructure and traffic engineering are useful tools to assess ideas and speed up decision-making processes. VCM may be used to check infrastructure, traffic engineering and ecological concepts prior to involving implementation costs.

Cairo

Cairo has been deeply transformed by the global dynamics of urbanization, which have increased the city's population by more than six times in the past 60 years. While the migration of rural populations has in the past represented one of the major factors fuelling this urban expansion, recent studies show that this is no longer the case. In 1960, an estimated 35% of Cairo's inhabitants were not born in the city. In 1996, only 12% were born elsewhere (Vignal & Denis, 2006). The capital's growth is now due mainly to natural increase and to the incorporation of surrounding villages and rural populations (Development Planning Unit & Urban Training College, 1999), while its growth rate of around 2% is not dissimilar to the one reported for the whole of Egypt (Piffero, E, 2006).

Cairo Informal housing now represents the dominant residential mode, there are very few shantytowns and proper 'slums' in Cairo.
Apart from some inner pockets and some of the more remote, recently urbanized fringes, the overall quality of construction in informal areas is reasonably good, especially where it has been consolidated. Nevertheless, because of their unplanned and 'random' construction—from which they derive their name in Egyptian Arabic, 'ashwa'iyyat, meaning 'disordered' or 'haphazard'—these informal areas suffer from problems of accessibility, narrow streets, the absence of vacant land and open spaces, very high residential densities, and insufficient infrastructure and services (World Bank, 2008).
Informal development has been, and continues to be, the dominant mode of urbanization in many developing countries, including Egypt.
It occurs especially on the urban fringes, on privately-owned agricultural land, rather than in desert areas, which would be considered squatting on state-owned land. Despite 30 years of attempts by the government to limit unplanned growth and urban expansion on agricultural land around Cairo, as it has in most Egyptian cities and villages, informal settlements around Cairo sheltered more than 7 million inhabitants in 1998 (Séjourné, 2006).

Methodology

An understanding of how the different layers of the city can be used as basis for design interventions, through rigorous exploration of the city from a regional and global context to smaller scale physical design; we developed the ability to reduce complex city systems into multiple interactive layers. By intensely researching the different system layers that underlie the city from human to infrastructure to ecological as well as examine the physical form of a neighbourhood they gained an integrated and systems-based understanding. In conclusion, we will come up with specific design solutions for various problems (fig. 3).
The four-dimensional space-time as a manifold in the space of a large number of measurements provides a real possibility of constructing a way for the large-scale structure of a four-dimensional physical space-time and, in particular, a mean for solving all cities intersected harms. Focusing on planning to produce space and using the temporal relations to spatial transitions will describe the impact of changing spatial structures on temporal patterns (fig 4).
Applying the layered dimension model of spatial transitions patterned will evolve patterns such as road patterns, social pattern, space typology pattern, transition patterns, etc., tracing changes and relations between space and time for each pattern will abridge the planning progression as a destructed layer. Then merging the new constructed layers all again in a whole map to form the new model. Respectively forming the city layered shape from the deconstructed layers, which has been well structured and studied one by one.
The points of intersections and interruptions will be clear in the merge process. That is to say working on each layer alone to fill up all the data and try to resolve all the problems and then work on the merged layers and locate the points of juncture come across solution to it. For example, the layer of roads to work on it and solve all the issues related to it, then during the merge process minimal intersections and problems as most of it is adjusted in the one layer process.
Since the Model can be linked with any kind of actual and planning data the VCM is a tool for acquisition and settlement discussions. Marketing relevant data like the economic potential, prognoses and site-related factors resulting from the working process of administration and economy can be made available easily.

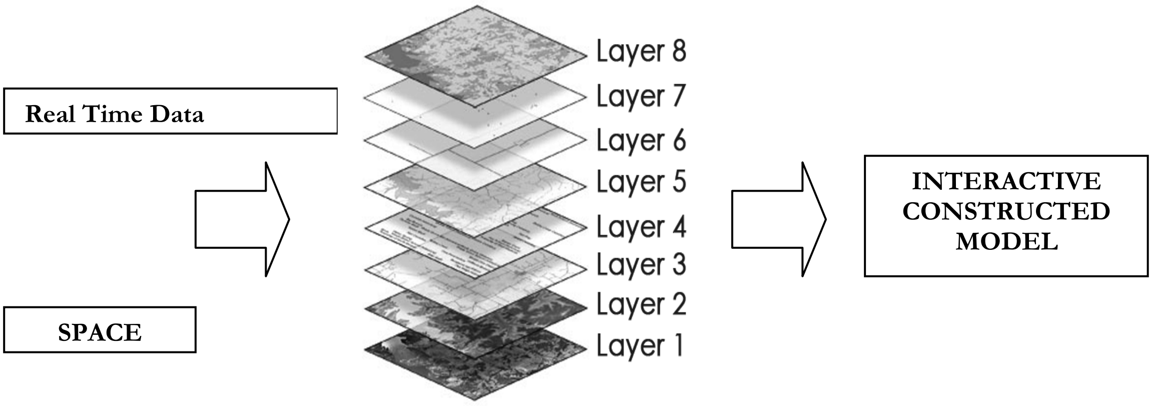

Figure 3. A conceptual diagram for the City layered and space- time Model

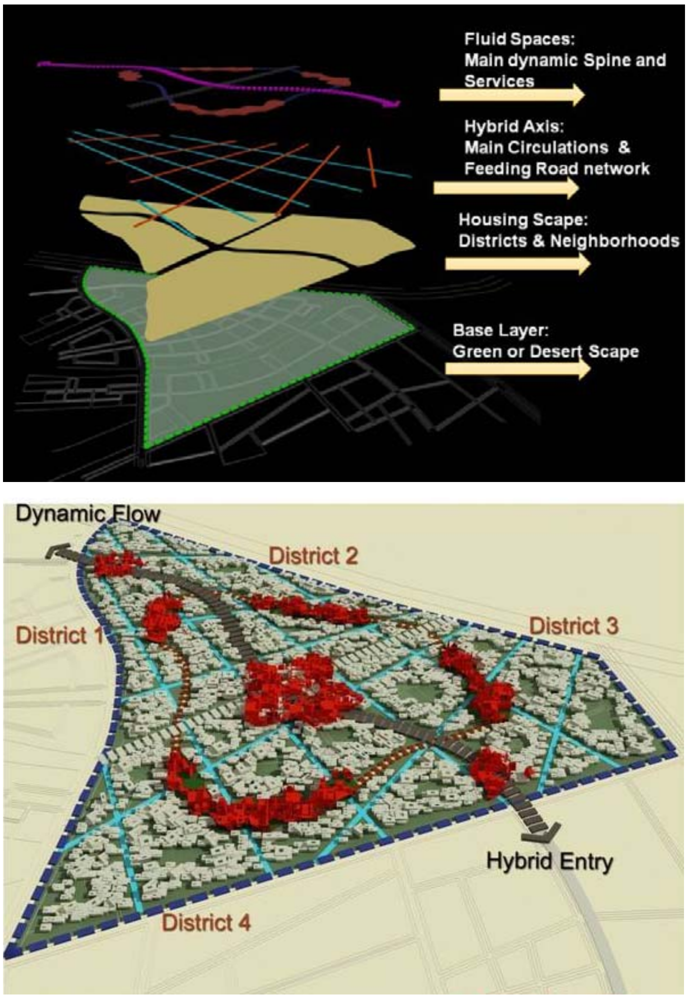

Figure 4. Application of the City Layered Model for new planned city

Case study I: A newly city planning process

The example shown is for a new city planning where we tried to solve the city components each one by itself. That is to say a way of deconstructing the layers and reshape it in a total way. We started the early concept also with a layering method which consisted of the following layers: Fluid spaces, Hybrid axis, Housing scape and a Base layer. Forming these layers in 3D and solving all its intersections and zones then overlaying all the layers over each other to form the whole. The next step is finding the harmed areas in the master plan and finds the suitable solution for it. Revaluating the plan standards to form the developed master plan and finalize its zones and components. Finally form the concluding 3D city or model with all the constituents of the master plan that comprises of: housing, roads, services, nodes and green spaces. Fig 5. The temporal model here was in the terms of the sales office management of the plots which reflected the client's needs so to modify the master plan plot areas according to the market statistics which was linked to the data base of the stock market. Where any raise or decline in the market values of developers, contracting companies and according to the indicators of the real estate market gave a representative data. Accordingly represented a new market need and is reflected on the master plan by pre-set queries or interactive solution link on the thematic map. For example if the market indicated a need of smaller plots the pre-set query will simulate the land division into smaller plots according to phases of the master plan. Again if the market needed bigger plots it changes it. Another example is installments percentages which is linked to the company position in the stock market where any gain or loss will be reflected on the amounts and percentages of installments for new clients.

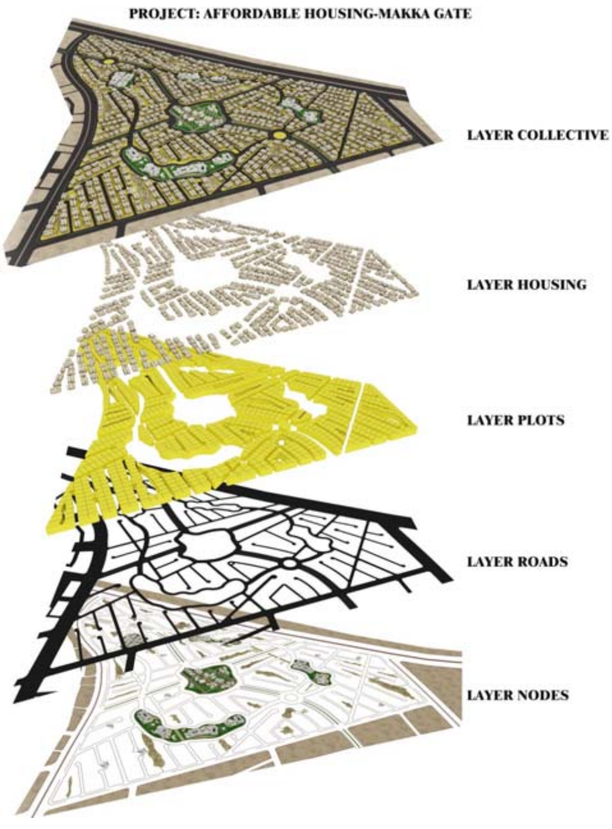

Figure 5. Showing the constituents of the city layers and final collective layer of the master plan

Case study II: An existing urban pattern

A sample was taken form a squatted area in Boulaq al-Dakrour, which is located in southern Cairo. Boulaq al-Dakrour, which has between 1 and 2 million inhabitants depending on the definition of the border of the district, is on the west bank of the Nile. The area stretches from Faisal Street all the way to Arab League Street. It is separated from Mohandessin and Dokki by the tracks of the Metro. The area used to be agricultural land. The farmers sold the land to people who started to build houses. Fig 6

The streets of Boulaq al-Dakrour are very narrow, straight, and extremely long. The pattern of the district follows the old pattern of the drainage canals of the former agricultural land. Houses are generally five to seven floors high. As there are nearly no open spaces in the densely populated area, lack of ventilation and light are an issue. The social fabric is more diverse than other districts. Many of the people of Boulaq al-Dakrour moved here from other districts within Cairo such as Saida Zaynab, Agouza, or Imbaba, all of which are popular quarters that started to become overcrowded by the end of the 1980s. Boulaq al-Dakrour is popular because it is quite cheap and its location is central. Many people work as employees in ministries elsewhere in the city. Even though there are the extremes of very poor and very rich people, most of the people are part of a broader middle class.

Figure 6. Showing the narrow streets of the district

The start of the project is to identify the study area and with a high resolution image we build up the 3D model and make sure that the layering system is working well and identified (Fig. 7). Layer roads is the main layer as it will have a lot of work on it, layer infra-structure which will include the water supply, drainage or sewage and power supply. Another layer can be done is for open spaces and also the layer block which will represents the housing tissue or pattern in the area.

The importance of the layer block is to see the overlay between it and layer roads when suggesting a new road. After the model is been constructed it can be worked layer by layer to form a rough solution.

In order to make the solution easily worked out we can divide the zone into smaller patches and then work out each patch and then assembly the patches together to form the whole map or layer. An over collective map will be formed to consist the solved map where we will trace the harm areas and intersection parts from the merge process.

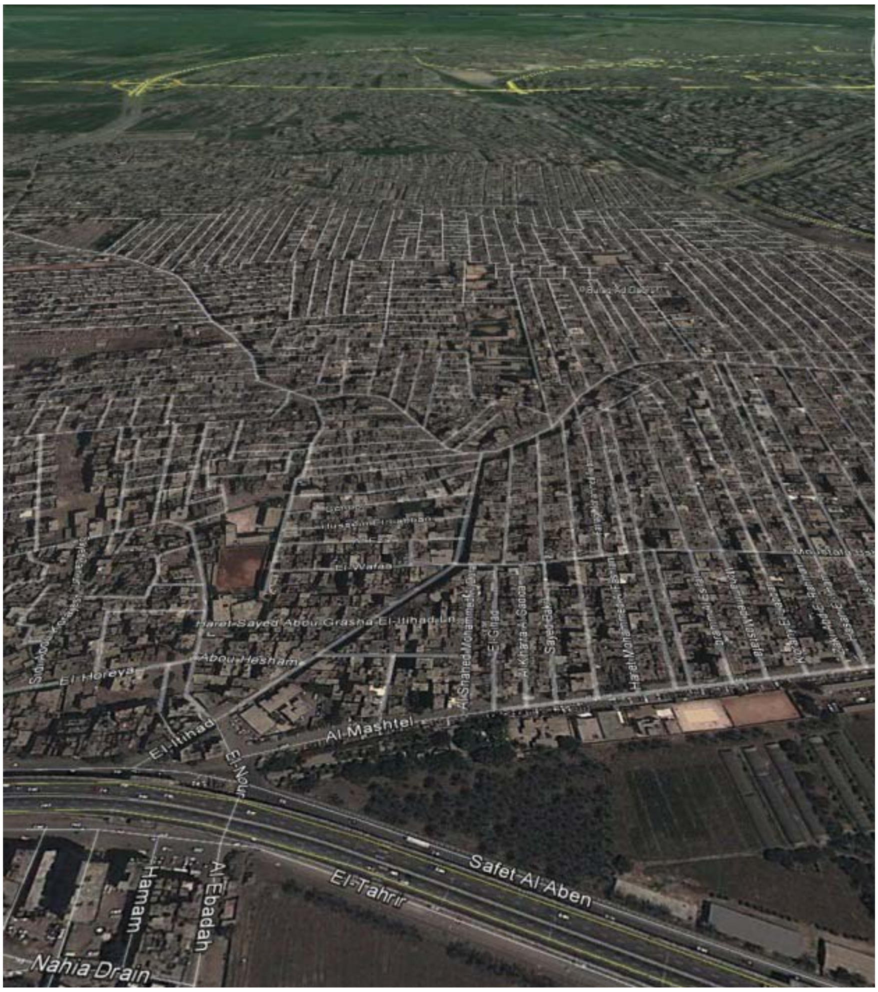

Figure 7. Boulaq al-Dakrour District as a study area

The temporal part will work in implementation of a pilot project and verify a sensor track to this area by radar or satellite imageries. Linking this sensory application to the map will create a real time working map which will monitor all the changes happing in the pilot project leading to second by second interactive map. This can be applied layer by layer on the GIS system to resolve the problems in Virtual Reality and monitor the change on the implication of any solution on the real work.
Below is a simple example of the layered map and the patch solution. The sensory part needs more information and applicable model (fig 8).

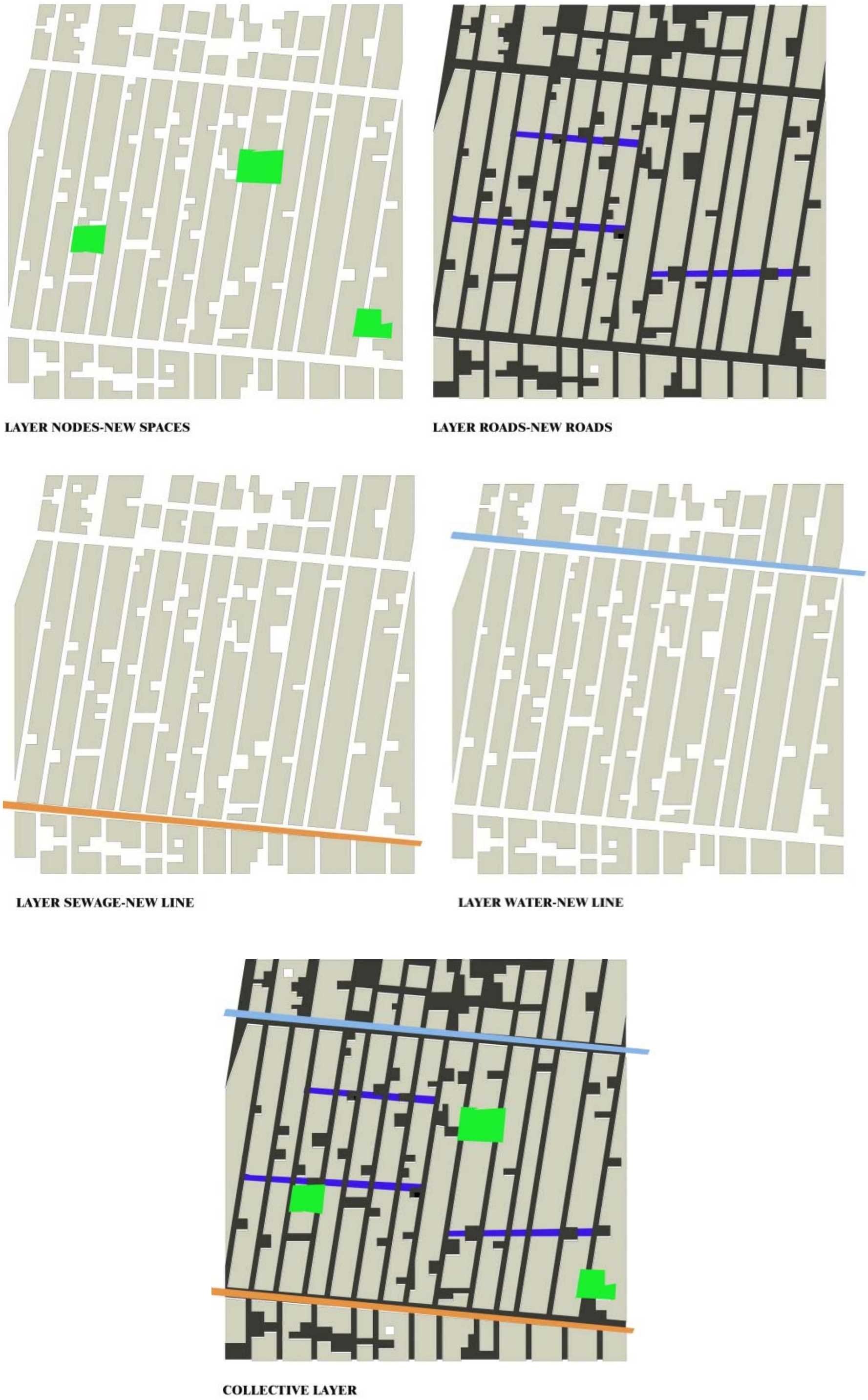

Figure 8. Patch layers as a pilot project area of the study area showing the propose new roads, spaces and nodes

The example explained is still in the experimental phase, the idea seemed in the beginning an impossible one but the commencing of the pilot zone gave some positive indicators. The start will be by the roads layer with a sensory indicator and monitoring cameras to perform the traffic impact assessment.

Understanding the demands placed on the community's transportation network by development is an important dimension of assessing the overall impacts of development. All development generates traffic, and it may generate enough traffic to create congestion and to compel the community to invest more capital into the transportation network, whether it is in the form of new roads or traffic signals or turn lanes. Traffic congestion results in a number of problems, including economic costs due to delayed travel times, air pollution and accidents. As one roadway becomes congested, drivers may use others not necessarily intended for through traffic.
All the gathered date from the sensors which measure the air and sound pollution also the statistical date of traffic and pedestrian trips and movement will also be shared with the other layers as open spaces and communal nodes.
The aim of this study is to come up with some guidelines to mitigate traffic congestion at the community level, encourage consolidation of trips by providing mixed use development, and encourage alternative modes of transportation. To be pedestrian friendly by including smaller set-backs, requirements for parking behind buildings, and building sidewalks—including sidewalks that provide connections from the development to residential areas.

Conclusions

Neighborhoods, cities and regions are complex phenomena. The way planners and urban designers think about and communicate their ideas about urban problems and their solutions is strongly, although not exclusively, visual. Visualization of urban planning and urban design is based on three premises (Dodge et al., 1998): To understand nearly any subject of consequence it is necessary to consider it from multiple viewpoints, using a variety of information; Understanding complex information about urban planning and urban design may be greatly extended if the information is visualized; and Visualization aids in communicating with others.
Communication and Visualization is at the heart of the planning system, the map and plan in two-dimensional form has been the norm, although extensions to the third dimension are important through urban design, which acts as the interface between planning and architecture. Other visual media such as photographs and statistical presentations through charts of various kinds also supplement the way such communication takes place. (S. T. Bhunua, et al 2010).
The potential of visualization in the planning and design of the built environment is very significant. The ability to represent, model and evaluate changes to the built environment on the computer desktop and over the Internet offers potential to enhance the planning and design process; and also help communicate ideas and developments to the public at large. Virtual City Models are designed for an interactive visualization and presentation by means of virtual reality tools and technologies. VCM may assist in the following fields: international, national and regional marketing and location promotion; decision making in choosing between various architectural planning options and in competitions for architects; preparing occupancy concepts; simulating infrastructure, traffic engineering and ecological concepts and furnishing information to the media and the public at large.
Further research is needed to study and evaluate current methods for generating reality-based 3D city models with the purpose to identify shortcomings and promising solutions. Also look into the problem of updating and maintaining 3D city models (4D city modeling), with the particular goal to find proper solutions for efficient change detection and modeling. Finally, a particular challenge will be the user specific visualization of the 4D multi-sensor data showing the urban objects and their dynamic behavior.

Visualization must handle spatially anisotropic data uncertainties and possibly incomplete dynamic information. It may also integrate some of the data fusion steps.
There is a growing need for novel ways to access the exponentially growing archives of historical imagery. It is imperative to go beyond cataloging, indexing, and keyword driven databases, to a paradigm where the computer at least partially understands the content of images. Pushing the state of the art in scene understanding and 3D modeling will enable radical new ways to view and experience historical and/or temporally varying imagery. The research described here aims at building time-varying 3D models that can serve to pull together large collections of images pertaining to the appearance, evolution, and events surrounding one place or artifact over time, as exemplified by the 4D Cities project: the completely automatic construction of a 4D database showing the evolution over time of a single city. (Dellaert F. 2007)
The research envisioned in this proposal will lead to a new kind of city models for monitoring and visualization of the dynamics of urban infrastructure and development in a very high level of detail. The change or deformation of different parts of individual buildings will be accessible for different types of users (geologists, civil engineers, decision makers, etc.) to support city monitoring and management as well as risk assessment.

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