

Research article

COMPUTER AIDED DESIGN AND 3D VISUALIZATION TECHNOLOGY: AN URBAN DESIGN IMPERATIVE

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Abstract:

Despite the glowing influence of computer technology in many disciplines of the built environment since the middle of the 20th century, urban design had been hardly touched for decades. Nevertheless, current advancements in computer technology particularly the development of CAD and 3D visualization soft ware in the past few decades has provided a platform for a paradigm shift in urban design process.

This paper extols the potentials of computer aided design and 3D Visualization tools in improving urban design. It argued that application of the new technology in urban design will not only facilitate better communication of ideas between the designer and his client group, but shall also make the act of city design much more economic and less time consuming. **Copyright © IJESTR, all rights reserved.**

Key words: Urban design, CAD, Virtual reality, 3D Visualization technology.

Introduction.

In the 21st century, pressure for increased environmental stewardship in development by the United Nations, have strengthened the importance of communication between the designer and the client, public agencies and the general public, as well as between the professionals and the lay groups involved in achieving sustainable development (Meeda B, N. Parkyn & D. S Walton, 2006). Consequently, governments of most nations have adopted modernized planning regimes that lay more emphasis on the full involvement of local communities at every stage of policy and project development. This requires first rate communication to fast track the consultation process. Good communication can establish early mutual understanding between participants in any projects and according to Meeda et al (2006), visual images and models can communicate what may be impossible, or at least extremely long winded in words.

In the field of urban design, rudimentary approaches to the production and presentation of graphic drawings to facilitate communication during the consultative process has been the norm even from the onset of the profession in the late 19th century onto the later part of 20th century. The manually produced graphic images were not only expensive but they were quite laborious and time consuming.

With the emergence of computers since the 1950s, several professions of the built environment have being tremendously benefiting from digital computing. In urban planning, development of appropriate software and tools have facilitated the computerization and analysis of complex municipal information systems and aided the modelling of transportation land use for decades. On the contrary, for decades urban design has been hardly touched by the digital world. Apart from dearth of available information in digital form, slow progress in the development of tools for graphic information representation was the major cause of the delay. Thus much of graphic presentations of urban design proposals for visual communication with the public were based on rudimentary manual approaches.

Nevertheless, in the recent decades dramatic advancement in computing technology, lower cost of hardware and software and the proliferation of technical skills according to Mahoney (1984) are set to increase the awareness of the potential usefulness of computer aided design (CAD) approach in urban design. Recent developments of AutoCAD software together with 3- dimensional (3D) tools for visualization and graphic representation could be tapped to enhance communication involved in urban design process.

Thus in this fast-paced and fast evolving digital era, it has become very important for urban designers and planners, to acquaint themselves with the elements and tools which computer aided design and visualization technology offers. This paper attempts to highlight the characteristics of Computer Aided Design (CAD) and visualization technology and its relevance to urban design; a review of literature on these conceptual issues therefore follows this introduction in the next section.

2. Literature Review.

i. The concept Urban Design

From a general perspective, design can be seen as the making of a detailed plan of the form or structure of something (an object) with emphasis on features such as its appearance, convenience and efficient functioning (Encarta dictionary 2000). In terms of residential design, Gilbert (1953) argued that the term refers to "...the arrangement of the various parts, the houses, roads, paths and public places in such a way that they function properly, can be built economically, and can give pleasure to look at". The implication of this is that urban design 'includes technical questions of urban functioning, economic issues of cost and benefit, aesthetic issues of appearance, as well as social issues involving allocation and provision' (Batty M, Dodge, Jian and Smith 1998). Urban design therefore is the process of designing and shaping whole neighborhoods and districts, and even entire cities, towns and villages to make them functional, attractive, and sustainable. This means urban design represents a synthesis of diverse activities involving social science and architecture. Consequently Barnette (1982) observed that it sits at the interface between architecture and planning whereby it represents a synthesis of diverse activities involved in these two fields.

From the late 19th century when city planning sprung up, urban design as civic activity was at its heartland in a social context. This was manifested in the early city beautiful movement as championed by Ebenezer Howard and other early architects. Urban design since then has however emphasizes the physical attributes which according to Batty et al, (1998) "restricts its scale of operation to arrangement of public places –streets, plazas and landscapes". Thus within the realm of overall land use planning in the city, urban design operates at a small scale. However, it is practical and broad based on its influence for many users of the urban environment to feel its impact. Thus, the wider public would always want to air out their views of how it might best be carried out. Consequently, urban design has great potentials to utilize any new technologies or practices that would facilitate communication between the professionals and the wider public.

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 CAD urban design. Other visual media such as photographs and statistical presentations through charts of various kinds also supplement the way such communication takes place.

ii. Computer Aided Design and 3D Visualization Technology

Computer-aided design (CAD) according to Narayan (2008) is the use of computer systems to assist in the creation, modification, analysis, or optimization of a design. Computer-aided design (CAD) and drafting employs the use of computer technology for the process of design and design documentation. This is achieved through the use of CAD software, which is a type of computer program that replaces tedious manual drafting with a fast computerized process. CAD software can help you explore design ideas, visualize concepts through animations and photorealistic renderings and simulate how a design will perform in the real world.

CAD software has different features depending on which design process is being used. One version provides features for two-dimensional (2-D) vector-based graphics, and the other version is for three-dimensional (3-D)

modelling of solid surfaces. While models are simply a physical representation or replica of an object, or idea, 3-D modelling is the 3- dimensional polygonal representation of such an object or concept, usually displayed on a computer with advancement in technology. Three-dimensional CAD software programs enable designers to apply multiple light sources, to rotate object in three dimensions and enables the designs to be rendered from any angle (Autodesk, 2012). This increases the productivity of the designer, improve the quality of design, and also improve communications between the designer and the public through improved documentation and visualization.

Visualization according to Charles et al (2004) is essentially the creation of a mental picture of an idea or object. Such picture According to Langerdorf (1992) can be translated graphically using computer aided design or computer generated imagery (CGI). The technique creates images, diagrams, or animations to communicate a message. Visual imagery has been an effective way to communicate both abstract and concrete ideas since the dawn of man. With recent development in computer technology, such images can be represented in 3-D as virtual reality images. Virtual reality as Bourdakis, (1997) argued is an artificial environment that is created with software and presented to the user in such a way that the user suspends belief and accepts it as a real environment. The simplest form of virtual reality is a 3-D image that can be explored interactively at a personal computer, usually by manipulating keys or the mouse so that the content of the image moves in some direction or zooms in or out.

3. Imperatives of 3-D Visualization in Computer-aided Urban Design

The impact of visualization in the planning and design of the built environment is very significant in that it offers great potential to the enhancement of the planning and design process.

Conventional approaches to presentation of graphic information to the public in main stream urban planning and design were through a 2- dimensional framework whereby, real world phenomenon were projected in Euclidean space in either vector or raster formats (Tomlin, 1990). This required layers of data sets to describe the urban set up. And as, such only experts could fully manipulate the complex layers for better understanding. The ordinary man was thus sidelined by such a system. Recent researches have come up with more appropriate software particularly the 3-D Virtual Reality Systems to overcome the limitations of 2-D Systems. Figure.1 gives an illustration of a 3-D computer block model of South Bank, Peterborough.

Such 3D virtual reality images according to Dollner et al (2006) and Bhunu et al (2002) can empower architects, urban designers, and city authorities to appreciate and analyze urban and architectural designs in the context of the existing situation. In fact, 3D virtual reality tool provide the fundamental infrastructure to begin building virtual cities which can provide an interactive simulation and analysis environment for planning and management of urban places.

Secondly, real-time 3D visualization and interactive exploration of models according to (Dodge *et al*, 1998) can facilitate planning and design processes by providing multiple stakeholders such as decision-makers, architects, urban planners, authorities, citizens or investors with a three-dimensional model that can help to identify design

errors or conflicts of interest, to arbitrate conflicts, and for facilitating understanding. Consequently, it has been argued that 3-D virtual reality facilitates more substantial public participation, making information more accessible and comprehensible.

Furthermore, it has been argued that this system can help identify design inaccuracies or conflicts of interest, to arbitrate conflicts and to aid understanding. And that use of 3D Visualisation tools can make the comparison of competing designs better. Figure 2.0 gives us an illustrative Comparison of model and current situation in real- time and virtual representation model.



Figure 1.0: 3-D computer block model of South Bank, Peterborough

Source: Meeda *et al*, (2007)





Figure 2.0: Comparison of model and current situation

Source: Buhur *et al.*, (2007)

Again in the design and management of urban utilities, 3-D Virtual Reality could be handy. Most often a maze of utility lines run underneath many urban set ups. Trying to track these in a 2-D set up would not give a realistic picture of their positions relative to the many foundations of buildings. However, new utility lines can be easily introduced in simulation exercises in 3-D Virtual Reality system without the danger of “hitting” into other lines or violating the construction regulations.

Finally the use of CAD and 3-D city models could be a cost saving measure both in terms of amount of energy used, time lapse and also financial cost. Often in the planning and design of cities there are so many stakeholders with diverse and often conflicting interests that must be incorporated in the overall design. This ensures that several consultations and adjustments are made with the stakeholders and on the original idea presented by the designer before final decisions are made. Thus it is not uncommon to see that the designed plan is continuously changed, reworked and updated and even several physical models on different planning scales are even created during the process. Digital 3-D plan representations in conjunction with 3-D city models might reduce costs and effort spent on preparing high quality presentations, map-print outs and physical models.

The above advantages notwithstanding, in the course of optimizing the use of computer graphic tools in urban design, a likely threat may be posed by computer modelling because of the close interrelationship computing has with engineering and scientific precision. Levy, (1995) noted that purposeful misrepresentation of a development proposal can be done in any medium. Finally, there must be a high level of sensitivity to the medium of computer generated images by those reviewing the images/ models. Those unfamiliar with such computer generated images/models (either at a basic or advanced form) may be captivated by their photographic quality and thus, will be distracted from the major issues under scrutiny.

4.0 Conclusion

The foregoing discourse posits that technological advancement in the development of software in the recent decades of the computer era and particularly the 3D virtual reality software has presented enticing opportunities to enhance urban design through improved communication avenues. Even though there is no guarantee that visualization will reduce the time spent in community consultation, it is hoped that this process will lead to better understanding between the designer and the public since a greater clarity of graphic information will reduce long winded verbal explanations and potential misunderstandings.

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