MULTIMEDIA APPLICATION FOR TEACHING THE BASICS OF LIGHTING IN PHYSICS CLASSES

Aikaterini Pigiaki, Dimitrios Zevgolis, Hellenic Open University, Department of Graphic Arts and Multimedia, Patras, Greece

Harry D. Kambezidis, National Observatory of Athens, Institute of Environmental Research and Sustainable Development, Atmospheric Research Team, Athens, Greece

Abstract
The creation of a simple or an interactive multimedia (MM) system can improve the presentation of a project and, in the case of the study of lighting it can facilitate the appropriate decision-making processing. This paper gives a case study of the effects of lighting in a residence in Athens. A simple MM presentation via a 3D model with animation has been prepared. The case study reveals: (i) the appropriateness of the MM presentation in a lighting design, (ii) the appropriateness of the MM presentation in teaching lighting in a physics class.

1. Introduction
The increased requirements of the job market and education in the sector of architecture led most of the architects to engage themselves in the world of digital technology. CAD systems that have expanded in the 3D design, photorealism, animation, and the creation of environments of virtual reality, have begun to become part of the process of architectural design and of the study of lighting, while the presentation of the results with the use of MM applications constitutes a common means of communication of architectural ideas (Sanders 1996).

The presentations with the use of simple or interactive MM can be exceptionally impressive and interesting for the spectator because of the 1D, 2D, 3D, or even multiD media and the interactive environment (Papakonstandinou 2004). The presentation of photorealistic depictions of the conditions of lighting can provide reliable information on the distribution of natural lighting and the design options of artificial lighting. Today, there are simulation programs that calculate the representations of natural and artificial lighting with sufficient accuracy (Dietrich 2006). However, the 3D animation of moving through space constitutes the most impressive element of the MM for architecture and lighting, since it contributes to the more efficient simulation of building, light, and textures (Vaughan 2001).

2. MM applications in architectural lighting
Education constitutes a basic sector of MM applications (Pombortsis et al. 1996). During the recent years, the use of MM applications is observed in sectors, such as architecture and applied engineering (Boardman, 2002). For the teaching of architectural lighting, the use of 3D models and MM presentations is expected to gain significant value as a means of improving teaching, as in this field depiction is the most important element of study (Vaughan 2001).

In the field of architecture, the use of MM is constantly increasing, since it can improve the presentation a project, and, in the case of the study of lighting, it can facilitate the appropriate decision-making, concerning design (Vaughan 2001). In architectural applications, the MM of indirect access (off line), are mainly used so as to provide the possibility of video projection or animation of 3D photorealistic models, while a better organization and presentation of the subject is achieved (Papakonstandinou, 2004). The simple MMs, in which the interaction is absent, are used more frequently (Dimitriadis et al. 2004).

Photorealism helps create safer estimations for the final image of a space, to effectively compare alternative proposals, to determine the precise natural dimensions, and mainly to transform information into picture. Although no program can accurately reproduce the visual experience that is created to a person when he/she is inside a building or an open space (Kontorigas, 2006), it can give a first impression on how the space will appear under specific lighting conditions.

Apart from the complicated specialized programs, such as Radiance, SUPERLITE, and DOE2, many types of software, such as 3ds Max, AUTO-SITE-LITE and LITE PRO, function in CAD bases, in order to be with more compatible with architectural design systems (Tripidakis 2008).
3. Case study
A study in an existing residence was conducted for the presentation of the effects of lighting through MM applications, with a simulation of the interior and the exterior space in a 3D digital model, in which the conditions for natural and artificial lighting were realistically attributed. Spaces were photographed under conditions of natural and artificial lighting and photographs were used as backgrounds for the subsequent planning.
The tasks that took place were:
− Modeling
− Mapping of textures
− Applying of lighting
− Creation of 3D depictions
− Creation of animation
− Creation of video
For the digital study of lighting, the following software was used:
− Modeling: AutoCAD Architecture 2008
− Photorealism-Animation: 3ds Max 2009
− Image Processing: Adobe Photoshop 7.0.1
− Video: Adobe Premier CS3
With regard to the artificial lighting:
1. an effort of rendering the existing facilities of artificial lighting was made
2. alternative options of lighting with the use of warm and cold lights were presented
3. observations on the already existing installations were made
For the rendering of the effects of natural lighting:
1. The prices of the intensity of the sun, from respective measurements of the National Observatory of Athens (NOA) were used (Table 1) for the particular day and time at which the photographs were taken (29/4/2008, 9:45 - 10:45 local time)
2. images of simulation of the natural lighting in the building were created for all the seasons of the year, by using the respective midpoints (Table 2)
3. The change of light during 24 hours was simulated by creating animation of lighting in an external elevation of the building
4. Alternative options of placement of the furniture and color choices of the surfaces were given

Table 1: Illuminance measurements at the location of the case study

<table>
<thead>
<tr>
<th>Month</th>
<th>Year</th>
<th>Hour</th>
<th>Minute</th>
<th>Total horizontal illuminance (lux)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>2008</td>
<td>9</td>
<td>45</td>
<td>61859</td>
</tr>
<tr>
<td>4</td>
<td>2008</td>
<td>10</td>
<td>0</td>
<td>65990</td>
</tr>
<tr>
<td>4</td>
<td>2008</td>
<td>10</td>
<td>15</td>
<td>71082</td>
</tr>
<tr>
<td>4</td>
<td>2008</td>
<td>10</td>
<td>45</td>
<td>81006</td>
</tr>
</tbody>
</table>

Table 2: Mean seasonal levels at Athens (Kambezidis, 2008)

<table>
<thead>
<tr>
<th>Season</th>
<th>Mean seasonal illuminance level (lux)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter</td>
<td>24310</td>
</tr>
<tr>
<td>Spring</td>
<td>45630</td>
</tr>
<tr>
<td>Summer</td>
<td>52270</td>
</tr>
<tr>
<td>Autumn</td>
<td>36940</td>
</tr>
</tbody>
</table>

For the presentation of the effects of lighting, photorealistic illustrations and animations were created in the space, which, with the proper processing, constituted a complete video of
browsing around the space, enriched with sound and titles that could be used as a basic element for the creation of an MM presentation for the study of lighting of the residence. From the whole study, conclusions were drawn with regard to

− the appropriateness of openings
− the placement of furniture, and
− the choices of the colors of the sources and the horizontal and vertical surfaces

Moreover,

− a first impression for the adequacy of the natural and the artificial lighting of interior was given
− examples of alternative options of lighting, coloring, and furnishing were presented for the documentation of the role of digital technology in the study of lighting

4. Conclusions

This study proved that MM applications, with the use of 3D photorealistic depictions and animation, can be used as educational tools in teaching architectural lighting or research on the facilitation of final decision-making by the professional architects and the best presentation of their final proposal to the customer.

The design and the study of lighting via 3D digital models and the presentation of the results via MM applications, present a number of disadvantages but also advantages, which should be taken into consideration by the architect or the scholar of lighting. The demands for hardware and software, the time-consuming procedures of learning the programs and the restrictions on the accuracy of the final product, can constitute a suspending factor for their use. On the other hand, the increasing demands of the job market, in combination with the potential of reducing the working hours, the production of more controlled and also realistic pictures during the phases of design and presentation of the architectural messages in a more complete way, justify the use of MM applications in the field of architectural lighting.

The scholar cannot rely only on the results of the digital models, since the study of lighting constitutes a complicated stage of the process of designing, but, through them, it can have an important first impression of the building, so as to better evaluate the results of designing and make the best possible choices. The use of MM is expected to prevail during the coming years in education for the teaching of the study of lighting and, therefore, it is expected that the role of interactive MM will be significantly developed, since, in this way, more realistic, but also more impressive representations of the proposed composition can be provided. Thus, as a long-term objective remains the complete presentation of proposals and ideas of lighting for a space, with all the potential and aesthetic qualities of an application.

References