Using Digital Devices to Find New Ways of Representing Audience Visibility in Theatrical Spaces

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Abstract. *The following paper is in keeping with other pieces of research which tend to broaden the role of today's computer tools so that they be seen as more than just representative. In fact, more and more studies focus on computer tools used as smart guides in the development stages of the preliminary concept. We therefore present a cognitive and interactive device with characteristics that address a theatre designer's requirements. It provides information on the visual quality of seats and optimizes their location in order to improve audience visibility. The working method we introduce will serve as a basis for future implementations when designing theatrical facilities and providing for audience visibility.*

Keywords. *Visibility; CAD; theatrical facility; digital devices.*

Introduction

Much research nowadays is focused on the need for finding tools to assist the designer in his task of conception through the early stages of his work. Computers have become one of those tools. They are no longer considered to be tools for representation but as thinking tools aiming to make the design process easier. Transforming these tools into smart guides can create new environments adapted to the challenges of future demands. To illustrate the impact of these technologies, it is therefore important to plot the changes that will occur in the design field. One of these changes is the aim of this paper, which is primarily to assess the diversity and potential for technological innovations, their interactions and the possible outcomes in designing theatrical facilities while considering audience visibility.

"Every performed art is a performer-audience shared experience entirely dependent upon the sensations of seeing and hearing. Anthropology teaches that in the long chain of human evolution these two senses developed gradually and at widely separated times. Seeing came first and for fundamental survival of the race is the more important..." (Izenour, 1996).

This research presents a study of audience visibility and how to improve its quality. Many of us have often suffered the frustration of being seated in a theatre and not being able to see the whole stage. This fact has been often analysed and for centuries. In the eighteenth century, for instance, the great philosopher Voltaire was aware of this

problem and described the ideal theatre as being the roman amphitheatre, with enough angle slope of the floor slab that can offer a good sight line to the audience (Figure 1). In fact, Voltaire was the first to suggest that the audience be seated. Until then, the audience had been in the habit of standing, gathered around the stage. (Bapst, 1971)

It was not only Voltaire that was concerned with the problem of visibility in theatres, but also great architect Nicolas Ledoux (late eighteenth century). The "visionary" aspects of his theatres showed that human visibility was a very important consideration as a definable component of audience conditions: according to the architect, everything in a theatre is related to the eye. This was obvious through Ledoux's representation of an eye and how the theatre is integrated into its main structure: the pupil. (Rittaud-Hutinet, 1982)

The breadth of past views raises questions for the definition of considerations when designing a theatrical facility today. The theatre design problem is one of the most complex in architecture because initially it allows less freedom to the architect. "If architectural design is to succeed a theatre design, the first consideration cannot be architectural aesthetics but how the audience, irrespective of theatre form, is to be brought into the best relationship to the performance. This requirement (desire of seated audience to both see and hear) has not changed in 2,400 years." (Izenour, 1996) It is possible to integrate and provide for some of these considerations when designing a theatre. Audience visibility can be considered within the framework of theatrical facility planning. Meanwhile, acoustic performance should be another key factor in theater design, although it has purposefully not been considered in this work whose primary focus is visibility. Understanding how past theories fit into today's concerns, can help us determine a functional, adaptive use of technology in designing theatre facilities.

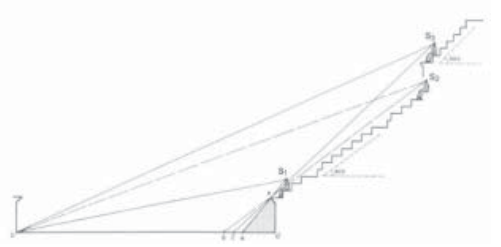

Figure 1. Perfect sight line according to the Vitruvio theatre

Devising a system to improve audience visibility

The past informed the present through a selective study of the history of theatre design and a detailed exposition of contemporary developments in the visibility problems inherent in the design of spaces dedicated to performing arts. (Campion, 1968)

Both our historical and exploratory research are fundamentally concerned with defining a system for seeing as this relates physically to performance, the basis for all theatre design. Our intent is to develop graphically the parameters of descriptive design geometry (Figure 2) and the laws governing these phenomena in such a way that computers are able to contribute in. As in Izenour's experience, physiologically the receptors of the seeing system are responsive to networks that connect to the brain, but their consideration is

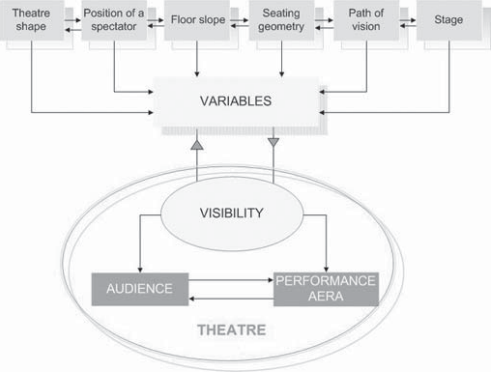

Figure 2. Diagram of the interactions between variables identified throughout the design process of a theatre model

beyond our concern here.

Experiencing a first model

In order to establish more definitive criteria for use in the design of theatre facilities, we first undertook a carefully controlled test program. For this investigation we used Autocad program, in which the Roman Thysdrus theatre (200 A.D.), located in Tunis, was selected. In this theatre the spectators, seated in an elliptic cavea, surround the orchestra. (Polieri, 1990)

We implemented a process model, which represented the audience's visibility. The procedure for this condition utilizes measuring functions developed by Golvin (1988) as he represents visibility by numbers. Visibility is divided for clarity into 8 categories of colours. Different colours shown in figure 3 provide information concerning the levels of sight lines: the sight lines to the arena are virtually perfect from every seat in the red rows. In contrast, all seats falling inside the light green rows are considered unsatisfactory for seeing into the proscenium stage. This prototype application specifies two information hierarchies: the space form and it's visual property. Upon analysing the results, we realize that we obtain a "dead space": trying to modify any parameter in the remaining model would require the hierarchy to be construct-

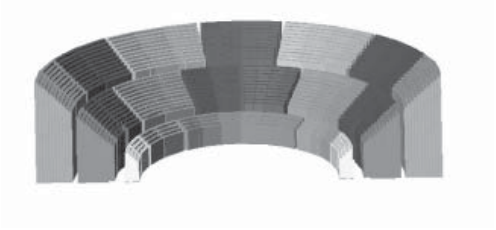

Figure 3. First computer model resulting

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Figure 4. Details of the procedure that integrates different parameters

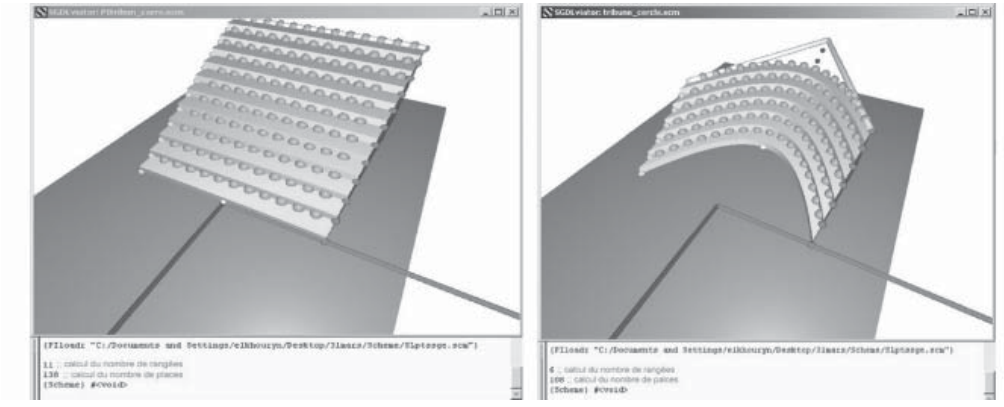

Figure 5. Possible transformation of the model informing about the seats number.

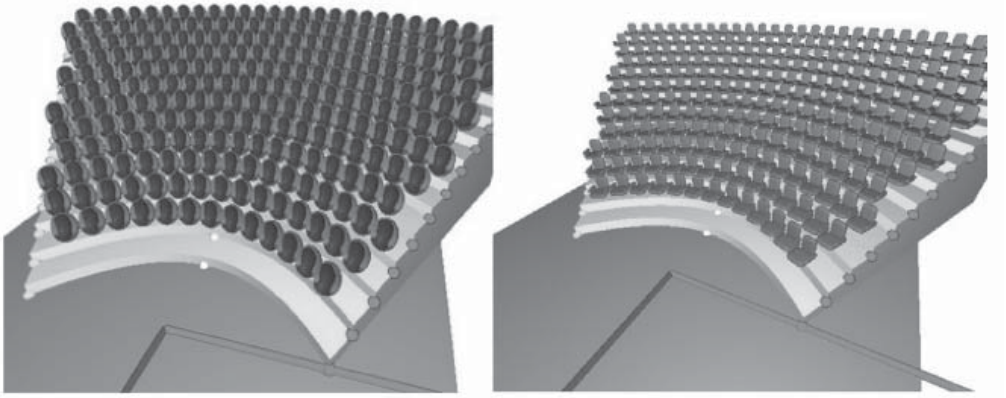

Figure 6. Distribution of the seats replacing the points.

ed again from the very first step.

This resulting model enables us to understand the goals of the methods we develop in the second experience.

Experiencing a second model

Beyond the fact of representing a computer model, we intend to develop a thinking model as a smart digital device. Being surrounded by a huge amount of programs we use a modelling system based on a functional programming language: Scheme. First we establish the functions and how they are organised within a system tool.

Then we propose a design tool that integrates variables identified throughout the design process of a theatre model. Each of those variables are introduced within the designing functions of the programming language as shown in the example of figure 4.

Having those parameters, translated into computer language, we first represent a seat location by points, easy to manipulate in a basic experience. Our first result was to conclude that information about the location of seats is possible through their co-ordinates. Secondly, the number of seats

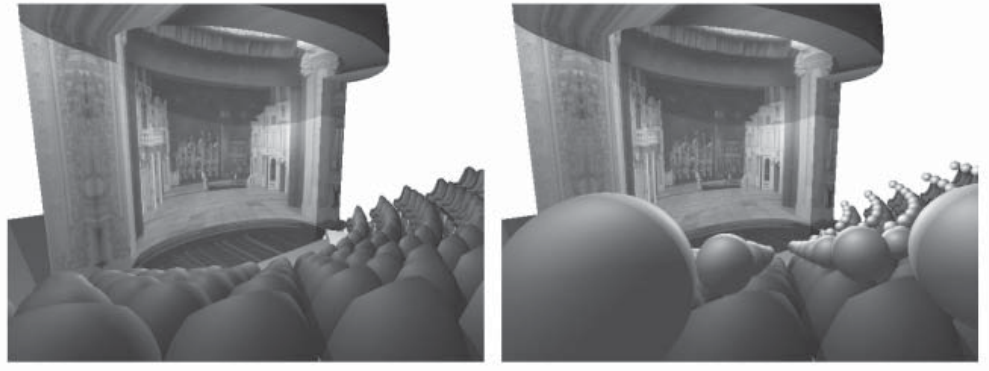

Figure 7. View of a scene and seats in the model experiment and simulating the spectators.

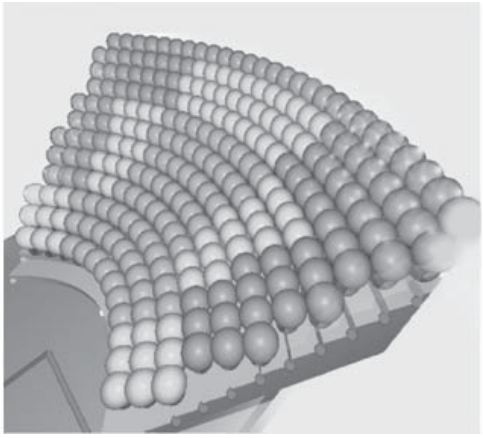

Figure 8. Example of gray scale repartition to qualify audience visibility.

Figure 9.Testing the digital device in Baalbeck (Leabanon)

Figure 10.Testing the digital device in Place des Arts (Montreal)

within a block of rows can be automatically calculated according to the theatre form we define. For instance, changing the theatre form instantly is possible by changing the value of one parameter. And by changing the theatre form, the visual quality of the seats is affected. So the system provides real time information for changes in seat location and in seats numbers depending on the shape of the theatre. (Figures 5) Manipulating a box of rows in real time can instantly, give the information concerning the seats number in a row, in a box of rows and consequently, in a whole theatre.

Continuing our experiment, the points were substitute by seats as in figure 6. The resulting computer model has the advantage of offering any kind of seat that could be directly integrated to the system.

This model has turned out to be a useful and flexible tool. It is indeed interesting to understand theatrical spaces through the eyes of the audience. But far more useful, and no less interesting, is the ability to propose a realistic theatrical space (Figure 7) and to vary subtle relations to improve the visual character of that space without having to start the whole constructing process from the beginning. (De Paoli, 1999) It is a way of reaching the conceptual step of the process at anytime of the work. These new methods aim to provide new architectural solutions through technological means, with an emphasis on information gathered on audience visibility in theatres. Visibility will no longer be a constraint as it can be considered at any step of the design process.

As an application of expressing a visual value for seats in a theatre we introduce to our seeing model a colour index. To qualify audience visibility, we use three main colours in the example illustrated in figure 8, red, green and blue (in this case three gray tone). Red (medium gray) is used to determine the number and location of good (acceptable) seats in an auditorium facing a stage. All seats expressed in blue (dark gray) are considered unsatisfactory for seeing into a stage. And seats

shown in green (light gray) are qualified in an average level. Dimensions of the space shown in the examples can be changed according to the theatre. So the system we present is adjustable and can improve theatrical design by considering audience visibility. It provides information on the visual quality of seats by optimizing their location.

Conclusion and perspectives

Based on research studies, we proposed a first computer model. This model helped us to clearly define our objectives. Then, we created a final computer model by using a functional programming language and a volume representation tool which met our target requirements more adequately. Historical and exploratory research was conducted prior to the following study which introduces a digital design tool that integrates variables identified throughout the design process of a theatre model.

The model presented in this paper will serve as a basis for future implementations when designing theatrical facilities and providing for audience visibility. It can also be used in historical places as in the court facing the temple of Bacchus (Baalbek) 150 years B.C. (Figure 9) and in urban spaces often transformed into stages with people gathered around. For instance, the Place des Arts in Montreal (Figure 10) is an outdoor theatre all year around. In both cases, the Bacchus temple and Place des Arts, it is appropriate to test our adjustable device.

This cognitive and interactive device, can be queried in such a way as to fulfil theatrical designers' requirements focused on improving audience visibility. Our research process helped us validate the working hypothesis implying that "in a theatre, it is possible to reproduce visual sight with a computer-based operational model and determine the location of seats to provide for audience visibility within such a theatre."

This paper does not offer to resolve the question about the best way of designing theatre facilities, more particularly, the complexity of including a visual constraint, but rather contributes to the development of a digital device as a tool to help the designer of a theatrical facility improve audience visibility.

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