

Pavol Mikulíček

ARCHITECTURE AND TECHNOLOGY OF 3D DIMENSIONAL PROJECTION

When we look back to the history, we find out that people have been looking for entertainment for a very long time. In general we may say that people work and celebrate and entertain themselves throughout the whole history of their existence. People have had their own requirements for entertainment in each period of time.

People have been always glad when they had opportunity to dance or listen to tales.

This evolutionary tendency is even more evident in the present time when people are so much involved in their work activities. We may say that nowadays people are more and more looking for the latest progress in entertainment technologies. The price of pleasure is not so important. People do not want to be bored and they are ready to pay for their amusement. Computer has substituted conventional games like chess or cards and theatre performances are often replaced with cinema etc.

It seems that enormous mental load (represented by education) and physical load (represented by a demanding job) have to be counterbalanced by equally interesting and fascinating entertainment activities. People want to be amused and entertainment companies want to earn money. This phenomenon is the main drive in developing new technologies and inventing new ways in this business.

We can see the progress in 21st century. The analysis of the latest progress in entertainment technologies is the subject of this study. The work will show one other interesting aspect, namely how one can integrate entertainment and education. We will also present how some recently new technologies will die out in near future.

The study is the first step in the PhD thesis, which aims at architectural design of spaces best suitable for the new entertainment technologies and entertainment concepts. The thesis will try to give an advice of how to design an ideal space for multimedia

production. The latest multimedia project technologies will be of core interest for this purpose. Their short analysis and outline of their history is presented in this study

We have a lot of information about 2D cinemas and their technology.

The age of 2D technology is more than 100 years old. We are able to see and trace its history back to 15th century, where actors used picture images shown on the projecting screen to evoke the atmosphere of a theatre performance. They used bottles with red wine and candles behind them, all positioned behind the projecting screen to get the red colour effect on the screen. People and animals were also standing behind the projecting screen and their shadows on the screen were performing the story.

This very simple technology was later improved, candles were substituted and actors have moved out of the cinema.

The 2D technology in fact substitutes the 3D real life and converts it to 2D flat screen.

In the recent decades filmmakers have been dreaming about giving the 3D illusion to the public.

Producing companies were able to develop the 3D cinema technologies and introduced them in Vancouver at Expo' 86 for the first time. The later enhanced versions appeared at Expo' 90 in Osaka. [1]

What is the difference between 2D and 3D technologies?

To understand the difference one should know the basic principal of human visual perception. We know that the left eye and the right eye see objects from different angles. If you look at an object through one eye and then the other, you will notice that the target changes its position. This is the principle of 3D photography. But if both eyes are open, the two images, which you have been seeing separately, will stick together as one image. This merge of both images is done in one's brain.

This 3D function of our brain allows us to understand space, depth and distance.

Charles Wheatstone used this principle in 1838. He constructed the world's first stereoscopic viewer based on renaissance theories of perspective. This invention was based on series of mirrors positioned in angles. Two separate drawings (one for the left eye and one for the right eye) were used to create the 3D image.

In this way Wheatstone established the start for the new era of motion and still photography.

This basic idea of 3D images has been preserved so far. The equipment of 3D technology system consisted of two 2D cameras. These two 2D cameras have been used instead two 2D pictures, which are described above. We can see one difference here: Still picture has been changed by motion picture. Two motion picture cameras are situated in 90-degree angle towards their target. The screen has to be curved because each camera takes a shot from a different position.

Later on, a single body 3D camera replaced the two cameras (*image 1*). It uses a pair of modified lenses. If you are looking for special effects, attractions, or want to make dramatic film, using the most intimate cinema

experience, this 3D camera offers a remarkable film making opportunity.

Now, companies, which are trying to progress even further in 3D technology, are acknowledged to be the world best in cinema market.

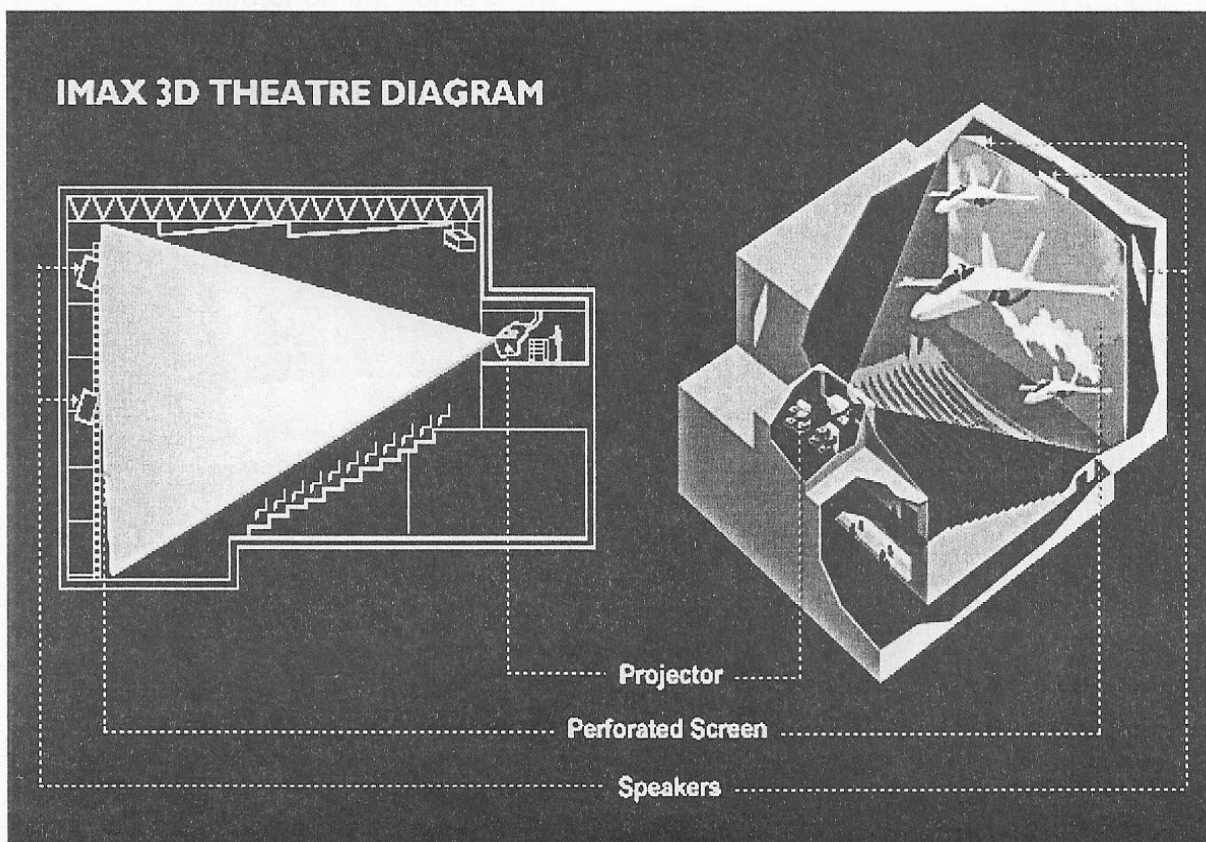
Recently a special 3D camera has been developed. It incorporates two camera movements into one housing. It is called "anaglyphic film".

This kind of film format simultaneously projects two different offset images from one single film. One image is coated with a green (or blue) colour, the other image is coated red. Spectators are given glasses that sort one green (or blue) lens and one red lens. The green lens of the glasses cancels out the image on the screen, while the red lens of the glasses cancels out the green (or blue) image on the screen.

Both separate images are processed by brain as one image. This system enables the viewer to see a black and white picture.

To have 3D coloured image one has to have images for the left and right eye (they must be kept separately). One has to use special Linear filter glasses or Electronic liquid crystal shutter glasses. [2]

Image 1



This technology is the best one for making films in human scale. Characters appear life sized and right beside the viewer. Stephen Low said that 3D technology was very natural and very close to conventional drama in theatre. [2]

Many people say that a 2Dimensional film is more realistic than a 3Dimensional film, and still leaves more space for imagination and for message of authors and director of the film.

Nowadays, the latest 3D technology enables the viewers to have their own home 3D cinema. They only need a personal computer or a laptop, special glasses and special software. The software can move two separate pictures and give them a different colour. The same principal is used by Imax 3D theatre.

Dome theatres (cinemas)

Cinema's dome experience wraps the audience in images of unsurpassed size, providing an amazing sense of real involvement. The dome is used instead of typical flat screen. The 2D screen is used with the dome theatre technology.

The most important part of this theatre is Dome, which is up to 30 meters high in diameter. In traditional technology the audience face the picture, but Dome technology pushes the viewer into the action.

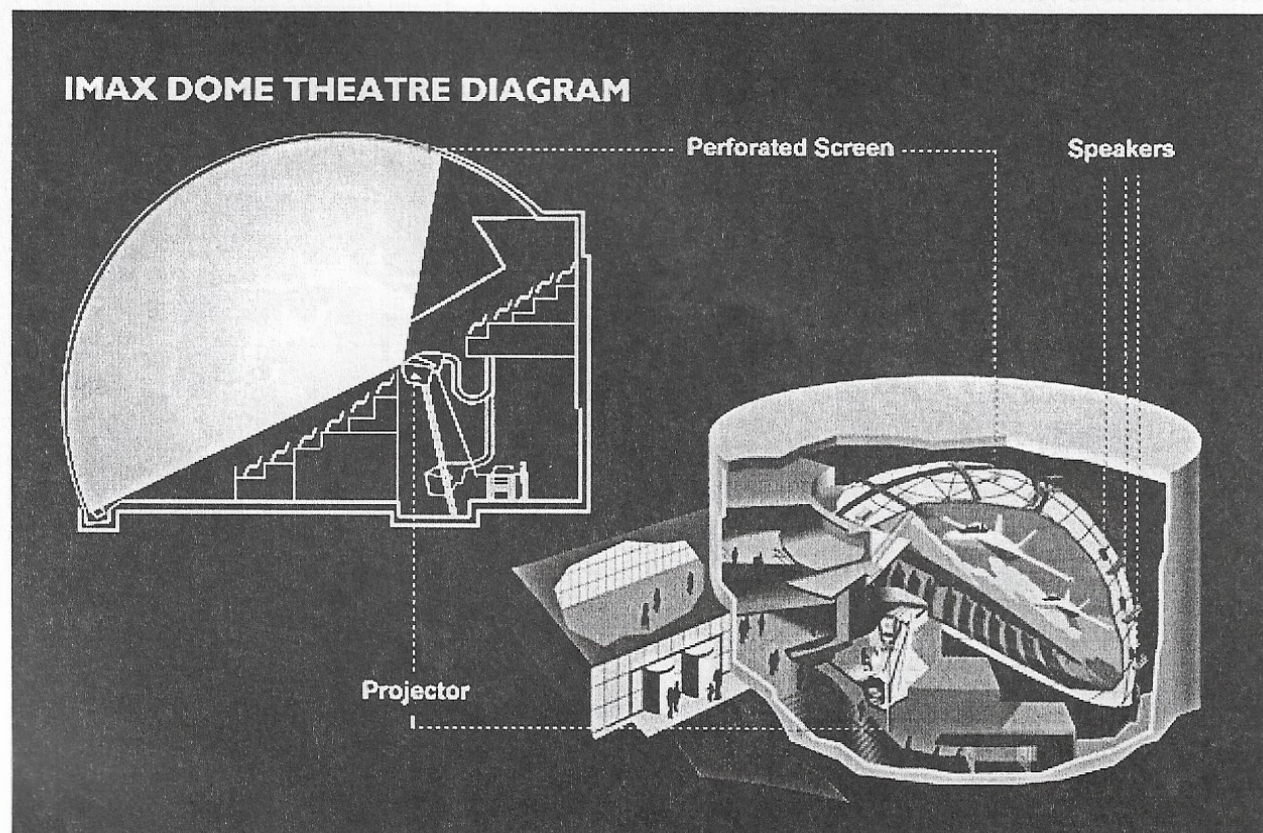
Audience is in the centre of the action. If you want to make a film, you will have to pay attention to the fact that the picture is all around you. Stephen Low explains, that it's impossible to do drama on the cinema's dome screen, because there will never be the right human scale. The dome utilizes fish eye projection on a dome screen, so the rest of the image looks unattractive, curved, bended etc.

The whole space is surrounded around the centre of the dome. Positions of seats are softly curved in the same way like the dome. Projector is approx. 2/3 of horizontal X axis and in the centre of Y axis. Projector has to be close to the centre of vertical axis. The operation room is under the viewpoint position (*image 2*). For better image the process of the film projection in operation room can be situated next to the entrance to the show room (with glazed walls). A good example of an Imax Theatre is in Cedar Rapids, Iowa, U.S.A.

Confrontation of planetarium's dome and 3D dome

At present, very old technology for planetarium is still in use. The projecting technology is sometimes 50 years old and it is uneconomic to use it. An analogue projector, which consists of a lot of lenses, has to work with

Image 2



many other kinds of slide projectors. It is necessary to use "plane-tarium" in the centre of the dome and slide projectors, which are situated around the dome.

The main difference is that the 3D dome doesn't use the whole area of the dome and that is the reason why the 3D cinema dome is used mainly for commercial use and the Planetarium dome for educational purpose (planetarium exactly simulates the whole sky).

The latest progress is represented by "Virtuarium", where one is able to find "future" technology. Silicon graphics computers manage the whole projection with RISC processors without any analogue technology. The computer generated imagery CGI is used to maximize the 3D illusion. Use of computer created images allows filmmakers a total control over convergence and focus, the two most problematic aspects of life action in 3D production. By creating the environment in the computer, the point of convergence can be precisely set by the filmmaker. When the film is projected on the screen, you will absorb visual information much like you would in the real world.

Digital projectors, which are connected to the computer, are surrounded around the centre of the dome. This "real" screen is not deformed because it is made up of several 2D screens by computer on the dome area. This technology requires very fast computers, which are built on RISC processor basis, so that's the reason why this sort of theatre technology is unusual and expensive (Futuroscope, France) – *image 3*

Other 3Dimensional projection technologies

- **Laser projection:** Laser rays project computer-generated picture on the screen. The screen consists of the net and the frame. The projected picture can only be linear.
- **3D Simulator rides:** The attraction combines sophisticated hydraulics, multi channel sound and special effects. Audience are involved in the story plot. The audience have to fasten the belts because seats are moving to the sides. This is real simulation of the real story. The largest scale simulator project is "Race for Atlantis" and the Imax 3D motion simulator ride (Universal studios Florida and California). The same principle is used for air craft pilot training simulators. [3]
- **3D theatres:** It is combination of cinema and theatre. The film is projected on the screen as a background and at the same time an exhibition by real actors is running. The conventional projection screen is used hand in hand with the theatre stage. (Used in James Cameron's Terminator 2 3D) [4]

Cinema and the sound

A lot of people think the picture is the most important part in cinema. It is a false notion, because sound and picture go hand in hand. A picture without sound could remind the oldest Charlie Chaplin's motion pictures. High fidelity (HI- FI) or Ultra high fidelity (UHI FI), and Low end represent the latest progress in the film and sound. It is important to know the answer to the question: "Which kind of production shall we use?" There is distinction between several main cinema

Image 3



productions and their connection to the sound system.

a) 2D production and Imax basic 3D production

aa) Mono sound- "Mono" means "One". There is used only one sound channel with several speakers. An analogue system is usually used (tapes etc.).

ab) Stereo sound (Dolby stereo) "Stereo" means "Space". Two sound channels are used. Each group of speakers is used for each side of the show room.

ac) Dolby surround: This technology was found by the Dolby brothers. The sound is delivered to 5+ 1 channels (the centre one, situated in front of the audience, the left and right channels next to them, and the two channels behind the audience. One channel is the subwoofer (ultra bass speaker) it doesn't have a firm position).

ad) PSE Personal sound environment: adds two sound channels to deliver the individualized sound to each viewer. Each viewer receives a different sound. The sound is delivered by a computer according to the number of seats to each position. Each person in the audience wears specially adapted headphones which are often built into the Electronic Liquid Crystal Shutter glasses.

b) 3D dome production

ba) DDP Digital disc playback: It is mainly used by 3D dome technology. It uses up to 8 tracks pure digital sound Samplelock technology.

bb) THX, DTS Digital theatre system: It is the mark of quality. Each producing company have their own evaluation team, which is able to give this mark to the selected cinemas (The sound is the evaluated aspect only).

In recent decades it was feared that the cinema performances are going to die out. Computers have already become a part of people's lives just like microwaves, refrigerators or some other appliances. They have brought computer technology into our houses, households and bedrooms. DVD or CD films, computer animation and 3D games. All this we can already find at home. Do people still need going to the cinema?

New technologies are not a matter of centuries anymore, not even decades. The outlined survey concerning the latest picture and sound projecting technologies used in film-making industry indicates that the cinema

performances are really not going to die out. Research and development, commercials and other costs make the new technologies expensive. Even the recently introduced home cinemas will for financial reasons not substitute public cinemas. The modern cinemas might have lost their romantic spell, but young and ordinary people will certainly keep visiting spectacular 3D performances where their dreams and fantasies will come true in the more and more realistic presentations.

Some people say architecture is a mirror of society. And it really is in its reflecting of our thinking, fantasy or way of life. New technologies going hand in hand with public interests represent a new challenge for architects in designing appropriate facilities and suitable interior spaces meeting technical, practical, aesthetic and convenience requirements.

The comparison of sound and video performance in this work is liaison guide in design planning of a 3D projecting facility where it is essential to take into consideration all three key counterparts of a facility – the **building**, its **equipment** and **services** it is designed for.

New cinema spaces, technologically so advanced and well equipped offer, apart from their primary function – entertainment, other new opportunities in an area still seldom spoken of. It is **education**. Films based on world famous novels, biographical or historical films used for subjects such as literature or history, documents from all over the world watched for social studies or geography, real dialogues or the work of speech organs simulations for foreign language teaching and learning, etc.

For the above mentioned reason this work can be interesting for architects designing 3D facilities as well as for teachers, business or commercial users (used for 3D presentations), for pilots, doctors, etc. to simulate reality. It is only up to us to find out what possibilities we have and learn how to use them.

Literature:

- [1] <http://www.imax.com>
- [2] Imax Ltd.: The 15/70 Filmmaker's Manual, 1999
- [3] Holosphere Magazine, USA, Summer 1987, Volume 15, No 2, p. 9.
- [4] J.Cameron: Terminator 2- DVD 2 special collectors edition, Universal, 2000