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SIMULATORS FOR LEISURE - A NEW INDUSTRY.

SYNOPSIS.

All training simulators are fantasy machines. The technologies used in simulators for aircraft and military vehicles are now being applied to entertainment. In most leisure simulators the audience is passive, as in a conventional theatre, but movement is added to heighten the sensory impression.

A leisure simulator should not be thought of as a videogame within a fairground ride. It is designed for use in a themed high-technology environment with a strong educational emphasis.

The leisure industry requires the development of robust, low-cost motion systems and simple, realistic CGI displays, which will open up new markets for simulation equipment in general.

SIMULATORS FOR LEISURE - A NEW INDUSTRY

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INTRODUCTION

There is a new breed of simulator which uses the best technology available to create pleasure and excitement for the general public. These machines are different from simulators previously designed, for several important reasons:-

1. Their purpose is to create a fantasy and not to simulate an accessible reality. For example, the general public do not really want to know what it actually feels like to hit the deck of an aircraft carrier or take part in air-to-air combat. They do not really want to know what it is like to take off in a Spacecraft or experience manoeuvres in a weightless Space environment. The public wants a fantasy sensation which is reality as they think it ought to be.

2. Everything is exaggerated. No aircraft turns may be properly banked, nothing is smooth, straight and level for more than a few seconds, Spacecraft can pull side-g during manoeuvres and there is music with the sound effects.

3. The simulators do not stand alone, but are part of a bigger fantasy, represented by the theming of their environment. For example, before climbing into a "flight simulator" the "passengers" go through "passport control" where a uniformed attendant ushers them into a "departure lounge" prior to boarding a civil flight. If it is a military theme they are given a "combat briefing" by a "flight commander" prior to take off. After leaving the simulator through another door, they pass through "debriefing" or perhaps "Space-port control" and there is always a souvenir shop.

4. Although a leisure simulator may be just a fairground ride in some installations, it is most profitable when it is enshrined in a carefully-contrived environment which emphasizes the expensive technology within the simulator itself.

EXAMPLES OF LEISURE SIMULATORS

Theatres

These machines are theatres because the audience is substantially passive, watching a visual display, hearing the appropriate sound effects and feeling the motion cues.

The simplest of these is a small capsule, holding 12 or 15 people facing a projection TV screen. Each member of the audience is encouraged to believe that he/she is alone in the cockpit of a fighter aircraft, a spacecraft, a submarine vehicle or a helicopter. The capsule is mounted on a motion system base which moves the complete assembly around fairly violently in correspondence with the visual display. The experience sequence lasts for about three minutes and is pre-recorded on video disc.

Larger units of this type have been constructed up to a practical limit of about fifty people, after which the size of the viewing screen begins to control the dimensions and the weight of the moving theatre and the cost of the hydraulic mechanism increases more rapidly than the throughput.

Stationary theatres can be constructed up to almost any size, using an individual motion cueing system for each seat or each block of seats. The decrease in physical motion disturbance can be recovered by an increase in the visual spectacle using wide screen displays so that the theatre as a whole retains its impact.

Large Interactive Theatres

An increase in the entertainment value of a simulator can be obtained by coupling an image-generation computer to a number of theatres and using a uniformed "captain" to fly the theatre through the database to provide an experience which is unique to each audience. It is also possible for several theatres to be flown interactively, the occupants of each being told to look out for the flight path of the companion theatres during the experience ("The other Spacecraft" for example). Formation flying, formation combat or even mutual combat can be simulated. The real-time interaction greatly enhances the vividness of the experience for all participants. It has been proposed that four theatres working in pairs could interact in real time with a CGI machine costing £1.5M and still make money for a British resort pier complex.

Transporter

There is a unique class of theatre which might be called a transporter. This takes the form of a small room in which the audience is requested to stand or sit for a short time, on their way to the main simulator experience and possibly on their way back. The transporter is mounted on a vertical axis short stroke motion system and is controlled in such a way as to produce sensations of movement and general unease, whilst the occupants are told that they are travelling through time or Space. The movement is emphasised by simple fibre optic or xenon lamp effects. In fact, of course, the participants do not go anywhere at all and just leave by another door.

Small Interactive Simulators

These are based on low cost computer graphics in contrast to computer-generated imagery. The low cost graphics are similar to those available in any video game but in this case a motion system is added and the seat back or helmet contains a stereophonic audio system.

Sports Training Simulators

It is now possible to use simulation technology as a serious aid to sports training. This applies in particular to those sports which require good aiming and balancing skills and the learning of fast reactions to unpredictable environmental changes.

The most obvious examples are Ski Training - on a moving belt supported on hydraulics and synchronised to a simple visual system: Hang Gliding - using a six-axis suspension system whilst viewing a projected display: and a Golf Range in which a real club strikes a tethered ball towards a projected golf course display. These simulators are in various stages of development.

TECHNOLOGIES

A number of simulation technologies can now be applied to the Leisure Industry in products of the type which I have previously described.

Computer Generated Imagery

Even crude 500 polygon CGI pictures are interesting to the general public when they are part of an exciting experience. Nevertheless, the public soon demands improvements to the "reality" of the picture and they are especially impressed by texturing, tree transparency, good clouds, battle smoke, target fragmentation and so on. As soon as familiar objects are displayed, away from the unfamiliar experience of the battleground or of pseudo-space environments, the public complains that buildings lack detail, for example. Recent improvements in photographic texturing are impressive and will overcome this problem.

Multi-channel CGI systems can provide a very exciting environment to the lay public entering a simulation capsule for the first time and they provide a feeling of largeness in the visual scene which cannot be matched by film without very considerable cost.

Multi-channel CGI picture generation can produce stereoscopic or pseudo-stereoscopic displays which are striking in their effect.

Million-polygon CGI displays generated off line and recorded on video disc frame by frame provide visually impressive artificial pictures whose cost can be justified by the large numbers of "experience theatres" in which they may be employed. Interactive simulators using video discs and image processing techniques can produce a fully interactive theatre simulator at a cost which is a fraction of that required for a 1,000 polygon real time CGI computer system.

Stereoscopy

A stereoscopic TV display makes a strong impression on the human brain as part of a simulation experience. It is not merely that the picture appears to have depth, but that there is a strong psychological effect which creates an impression of increased picture quality. The resolution appears to increase and the visual noise level is reduced by a correlation effect. The most striking benefit is a greatly-enhanced perception of movement - and movement is the essence of the most exciting fantasy experience in Leisure simulators.

Artificial stereoscopic TV pictures can be produced by a CGI machine. The polarised spectacles required for viewing conventional stereoscopic pictures can be built into Space helmets or similar artefacts which form part of the themed experience. Lenticular screen systems are now being studied for large Experience Theatres where there is an objection to the use of polarised viewing glasses.

Motion Systems

In a passive audience simulator there is no requirement to simulate yaw accelerations of the vehicle. When the accelerations are small there is no psychological effect, being equivalent to the normal rotation of the head from side to side when travelling. The disturbing part of a strong yaw acceleration can be represented by its sway component. This might be experienced, for example, in a racing car simulation. Because it is not necessary to match the motion experience to any true reality it is normally unnecessary to reproduce surge and sway motions which have a short rise time. These accelerations can therefore be coupled into the pitch and roll components respectively.

A general purpose 3-axis (heave, pitch and roll) system is normally adequate for Leisure simulation work. Since the motions are exaggerated and because the motion system is operated almost continuously for ten hours a day seven days a week during season, the hydraulic system components need to be robustly constructed, with particular attention to the type of seals employed.

Short-stroke hydraulic pitch, roll and heave motion mechanics are fitted to blocks of seats in some experience theatres; the hydraulic motion serving only to disturb the psyche rather than to overwhelm it with motion sensations.

The smallest type of Leisure simulator motion system is the pneumatic seat cushion and seat belt variety, which is effective in the presence of overwhelming visual simulation experiences such as those produced by wide screen or multi-channel displays. "Hot Seats" will be used in the largest simulator projects.

Audio Techniques

In a large theatre the most usual recourse is to multi-channel sound systems, reducing to a simple quadraphonic system in a small simulation capsule. Where the themed experience includes the wearing of a helmet it is possible to arrange for the sound to be fed into earphones, in which case the "artificial head" form of stereoscopic recording is employed to enhance the spacial effect, with conventional loudspeakers contributing to the environmental sound.

Olfactory Simulation

One company has specialised in the provision of artificial scents, quantities of which are introduced into the simulator airflow to create the right olfactory sensation. For example, kerosene near aircraft about to take off, hot rubber on a car racing track, cordite fumes in a battle area, sea air on the carrier deck and so on.

Spin Off

The large-scale production of simulation equipment whose development is financed by the Leisure Industry opens up markets in other areas.

The availability of low cost simulator systems which are manufactured in quantity makes it easier for third world countries to purchase training simulators for civil and military applications.

The attention-grabbing capability of large audience passive simulation techniques is being put to use in theatrical presentations for product promotion and company promotion seminars. Several large themed leisure projects now in the planning stage require the use of CGI technology to provide an interactive demonstration to a large audience in an individual-seat-motion theatre complex. This presentation technique is especially attractive for the most popular theme of Space exploration and for Local Authority projects which promote the attractions of the area in a theatre environment, interspersed with mock helicopter flights between one location and another. The use of seat motion and unusual visual imagery adds to the impact of information presented on an otherwise uninspiring subject.

Most large scale leisure projects are now intended to be semi-educational - that is to inform as well as to entertain. The educational side of these projects may be expanded in special sessions for school children and the programme of the Experience Theatre may be extended in scope to expound one particular aspect in depth at any time. Typical themes are local history, geography/geology, seamanship, cosmology and, of course, Space technology.

One of the most interesting spin-offs is a medical application in the treatment of phobias. The individual under treatment is led by the psychiatrist through a pre-programmed journey which enters, step by step, into the situation most feared by the patient. The advantage of the simulator is that it is possible at any instant to "freeze" the increase in stress or to fade the simulation down in its intensity relative to local reality. The patient is therefore trained to become gradually more confident in the phobic situation.

SUMMARY

Simulation systems are now becoming a part of the Leisure industry, because their effect is to take a stronger grip of the human psyche than is possible by other means. The machines are safe, do not take up much space and, being enclosed, can operate in all weathers.

Important information can be firmly impressed upon an audience in a pleasurable manner.

High grade training can be provided for those sports in which the novice is at considerable risk, where training time is very expensive or the physical resource is at a high premium.

A recent report for a UK Government study group recommends that the Leisure applications of simulation technology should be studied as an important diversification of the industry.

Phillip Denne. September 1986.