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In the application, the user is able to explore a 3D world from the Jurassic era. In this world there are dinosaurs, prehistoric plants and natural features. Extensive narration is triggered by the user's exploration. The result is that similar content to the TV documentary is presented, but in a non-linear, interactive way.

The paper describes the immersive application, how it was created and the results of user testing.

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SIMUTAINMENT: A FACTUAL TV DOCUMENTARY AS A 3D INTERACTIVE EXPERIENCE

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ABSTRACT

Simutainment is an experimental project to take the content of a factual TV documentary and present it in a novel 3D interactive form, somewhat in the style of a computer game. The aim is to combine the excitement and interactivity of a computer game with the wonder and learning of a TV documentary. An immersive application for PC has been developed, using a programme on dinosaurs as subject matter.

In the application, the user is able to explore a 3D world from the Jurassic era. In this world there are dinosaurs, prehistoric plants and natural features. Extensive narration is triggered by the user's exploration. The result is that similar content to the TV documentary is presented, but in a non-linear, interactive way.

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INTRODUCTION

By far the most successful form of interactive entertainment is the computer game. In late 1998, Nathan Williams, a science TV producer, wondered how the values of a TV documentary could be brought to this interactive medium. He felt it should be possible *to combine the excitement and interactivity of a computer game with the wonder and learning of a TV documentary*. He presented his ideas to a BBC innovation group ("Imagineering") and was given time and funding to develop them further. After completion of a brief feasibility study, the project was put to one side for a while but taken up again in 2000 with a project to build a proof-of-concept prototype. This was completed and considered successful enough to be developed further into a form suitable for release to the public. At the time of writing (April 2002), the final product is shortly to be published as a free download on the BBC web site.

Following an Invitation to Tender, game development company Asylum Entertainment Ltd. was selected to work with the BBC on the project. Asylum built the application with editorial direction from the BBC. The relationship was managed with Asylum as a contractor to the BBC.

The subject matter chosen was the successful BBC TV series "Walking with Dinosaurs" and specifically a programme entitled "The Ballad of Big Al". The concept could be applied to many kinds of factual documentary but this subject was thought to be particularly suitable and likely to appeal to a wide audience.

At the heart of the interactive concept is a rich 3D environment which the user can explore. It contains several species of dinosaurs which behave in a life-like manner through the use of simple artificial intelligence rules. There are also prehistoric trees, plants and natural

features. As the user explores and observes this world, appropriate narration, in TV documentary style, is triggered. A further narrative element is added by a number of "news events" which gradually unfold.

To add a sense of purpose, the user has a list of things to find in the world and when the list is completed, a reward in the form of a flight with a pterosaur is provided.

User testing has found that this form of interactive presentation is particularly appealing to children and clearly has educational potential.

DESIGN

Environment

The user is placed in an immersive 3D environment which they explore from a first-person viewpoint using keyboard and mouse controls for navigation.

To achieve a TV-like feel, high quality graphics were needed. Furthermore, a varied environment was needed to maintain the user's interest. Given the technical constraints on graphics and data, these aims were best achieved through an environment composed of relatively compact zones. These include desert, mossy, forest and volcanic crater areas. The zones are connected by narrow pathways which the user has to find. The differences between the zones are explained, with a little licence, by altitude differences; the pathways between zones generally taking the user up or down hill.

Figure 1 shows a typical view while exploring the desert zone. There is a Diplodocus in the foreground, an Allosaurus behind and to the right, and a pterosaur flying overhead.

Electronic Field Guide

During exploration of the immersive environment, the user can consult an "electronic field guide". This includes a map, a set of icons depicting things to be found and instructions for the keyboard and mouse controls.

Figure 2 shows the map screen. The layout of the different zones can be seen together with dinosaur locations and small stars indicating where items have been found. Below the map are the icons depicting things to be found for the zone you are in, as well as animal and plant species to find in the entire world. In this example, they are all ticked, indicating that all the items in the current zone have been found, as well as all the generic species. When a user clicks on these icons, he will hear either a hint as to what to look for (before discovery) or a description of the item in question (after discovery). If there is a current news event, the location of this is also shown.

Dinosaurs

The visual appearance of the dinosaurs was particularly important in order to achieve consistency with the television series. Clearly it would not be possible to achieve the same quality as the computer-generated imagery in the television programmes; this is a real-time application, some of the TV sequences required up to one hour of render time for a single frame. Nevertheless, high quality was sought and achieved. Reassuringly, one child member of a focus group commented that not only was a dinosaur recognisable as an Allosaurus, it was recognisable as the Allosaurus from "Walking with Dinosaurs".

Two main species of dinosaur feature in the application: the herbivorous Diplodocus and its predator, the Allosaurus. In addition, the well-known Stegosaurus is included. Low-detail pterosaurs fly overhead.

The behaviour of the dinosaurs is controlled by artificial intelligence rules. For the Diplodocus, these govern hunger, feeding, fear of predators and herding. For the Allosaurus, the rules govern hunger, stalking and attacking prey, and stand-offs with rivals.

Special effects such as dust thrown up by the feet of the dinosaurs, and camera shake when you get up close, help enhance the realism.

The dinosaurs are programmed to be occasionally aware of the presence of the camera even though notionally the viewer is 'invisible'. For instance if the camera gets in the way of an Allosaur, it will stop and roar. However it will not attack the viewer. Similarly the creatures will occasionally turn to look in direction of the camera. These features help to provide a sense of excitement and immersion in the environment but a documentary feel is preserved by not giving the viewer an implied bodily form.

Narration

The narration system has to deliver documentary-style narration but in a way which is responsive to the user's exploration. This has been achieved with good results and the method may be useful for other forms of non-linear narrative.

The narration is written in short bite-sized chunks which we call narration units. Each narration unit is no more than about five seconds long. In fact most narration units will amount to a single sentence.

A narrative explanation may be made up of a number of units which successively qualify what is being said. We could call the first set of triggered units A1, A2, A3 and call this set a paragraph.

The user will always hear the whole of a unit once it is triggered.

After each narration unit there is a pause. If the user is still in the trigger area, the paragraph will continue. If the user has moved on, the next unit will not be played, but those already heard are designed to make sense without having to hear the full paragraph. If the user then return to the same location, they will not hear the rest of the units in the paragraph (since they are designed to follow the previous ones logically). Instead they will hear the next paragraph (e.g. B1, B2, B3 etc), if one exists.

Here is an example:

A1 "This tiny skull is not that of a dinosaur."
A2 "It is that of an early mammal"
A3 "How it ended up here is a mystery"

B1 "These are the remains of *rodentis unfortunatus*"
B2 "A creature no bigger than a shrew"
B3 "One of many such species holding the torch for mammalian evolution"

C1 "Perhaps this mammal made its own way here and died"
C2 "Or maybe it was brought here by a pterosaur"
C3 "It is hard to imagine that its descendants will outlive the mighty dinosaurs"

The user might for instance hear A1, stay to hear A2, then leave. Coming back the user would hear B1, then perhaps leave again. Returning finally the user might more patiently listen to C1,C2 and C3. The overall effect is of a logical set of statements.

In this way there is generally no repetition of narration, but the amount of narration need not peter out after your first tour of the environment.

Events

Some elements of linear narrative are included through "news events". At suitable times during the exploration, the user is told of a news event, for example, "The sound of two Allosaurus roaring disturbs the plains. It comes from the echoing enclosed area at the head of the dry river." The user should then visit the area in question and will see the news event, in this case a fight between two Allosaurus over the carcass of a Diplodocus.

The timing of news events is adapted to maintain the user's interest. If the user is busy exploring and discovering things, news events will be held off. However, if the user has spent some time without discovering anything new, a news event may be triggered to provide some excitement.

Discoverables

A game-play element is also included. The user has the task of finding all the animals, plants and features shown in the Electronic Field Guide. When this has been achieved, the user is rewarded by a flight with a pterosaur and taken into a new area.

Other Features

A function is provided to allow the user to attach the camera to any creature that is close enough. The user can then 'ride' with the creature as it moves around, and move the camera around it to get close up views. This has parallels with camera shots in nature documentaries where the camera it attached to or follows closely the animal subject.

Another feature is the ability to leave instances of the camera anywhere in the environment (dubbed 'stakeout cameras'). The dynamic map in the Electronic Field Guide then records their location, and the user can return to them at any time. This too has a parallel in wildlife filming where a remote camera is left to monitor events.

Combining these two tools, the user can leave a stakeout camera attached to a dinosaur and return at any time to see what is happening to that individual. Along with the news events the stakeout feature helps to provide a 'meanwhile…' sub-plot element to the narrative which will be familiar to viewers of TV documentaries.

IMPLEMENTATION

Re-use of Material from the Television Series

It was hoped that dinosaur models created for the television series "Walking with Dinosaurs" could be used as the basis for the Simutainment models. In practice, it proved easier to re-create the models using visual references and without import of data. The reasons were logistical as much as technical but the lesson is that 3D content should be produced with re-use in mind from the outset.

Other material was successfully re-used. Most importantly, the research that went into the programmes was used in designing the environment and in writing the narration. Some existing audio effects were also used.

Artwork

The Diplodocus model was created as a 50-bone skeleton covered with two level-of-detail skins; one for close-up and one for distant viewing. The close-up skin comprises a specular-mapped, 2000-polygon mesh, while the long-distance skin uses 600 polygons. A lot of effort went into accuracy; for example, extra bones were placed in the creature's underside so that

when it walked, shockwaves rippled right up its body. Allosaurus and Stegosaurus models were similarly produced.

Graphics Engine

The application uses the "Q" graphics engine from Asylum's sister company Qube Software (http://www.qubesoft.com/). This technology has been designed with the potential in the future to allow the Simutainment content to be delivered by streaming rather than as a large download. This possibility is significant in that it gives the basis for a form of 3D broadcasting - interactive 3D content delivered over the web to the end user in realtime.

Data Compression

The completed application was to be delivered as public service content (i.e. free of charge) and the simplest method of distributing free content is internet download. The drawback is that the amount of data that can be downloaded in a realistic time is limited. After a good deal of discussion, a limit of 20 MByte was agreed. This is a long but feasible download for analogue modem users, taking of the order of 1 hour to complete. For broadband home users or people using the internet at work, of course, the download is considerably quicker.

Audio, as is often the case, was first to be squeezed. In addition to music and sound effects, over 300 sentences of narration were required. Much of this audio was compressed using MPEG Layer 3 coding. For example, narration was coded at 24 kbit/s mono, which was as low as we could go without heavily compromising the quality.

Next was the graphics data. Textures were compressed and the total number and size of textures was limited in order that when compressed into graphics RAM they would not exceed 8 MByte. This helped maximise performance, minimise data size and put the application within reach of a wider range of machines.

The 3D world makes extensive use of "instancing". This means, for example, that instead of creating every single tree, a few representative trees are modelled and the landscape is populated by cloning these in large numbers after loading.

The landscape was designed to be varied enough to keep the user interested but finite enough to keep the polygon count within reasonable limits.

Testing

During development, the various software builds were tested by the developer (Asylum) and the customer (BBC) and all bugs and "features" noted for attention. In the latter stages of development, an external testing house was commissioned to test the software on a wide variety of hardware.

USER REACTION

Focus Groups

After the original prototype was completed, Focus Group sessions were run with six groups of children in the 8-14 age range and one group of adults in the 23-35 age range. Among the topics discussed were Concept, Platform and Narration.

Concepts.
Some alternative concepts were put to the groups:

Concept A: Explore "Explore Prehistoric times with everything explained as you see it, so you can understand how dinosaurs really lived"

This concept was seen as original and fascinating by some (adults, teenage boys) but as boring and educational (off-putting) by others (teenage boys, younger boys and girls). The ideas of exploring at your own pace or riding on a dinosaur's back were popular but more activity was wanted.

This concept was seen as the best fit with the current BBC stereotype.

Concept B: Game "Be a dinosaur in Prehistoric times, where you must explore, hunt and eat in order to survive"

This concept was popular with the 10-12 age range and male adults, but slightly disturbing for the 8-9 female group. The sense of mission was popular across the board with some particularly liking the idea of eating other dinosaurs. It was still seen as having educational value but in a more involving way than Concept A.

This in combination with Concept C (below) was the most popular concept spontaneously generated by the respondents.

Concept C: Create "Put together your own Prehistoric world, by adding dinosaurs, trees, changing the weather and scenery and then watch what unfolds"

This was popular, particularly with girls. Respondents liked the element of control and would have liked to extend this to designing their own dinosaurs and controlling them after adding them.

This concept was, however, seen as similar to existing simulation games such as "Roller Coaster Tycoon" and "Sim City".

Platform.
The groups were asked about PC vs. Console as platform for this kind of content. The PC was strongly viewed as most appropriate. This was partly due to the educational aspect and partly due to slow-paced nature of the interaction (no need for frantic manipulation of the controls).

Narration voice.
The narration used for the initial prototype was very much in the style of the "Walking with Dinosaurs" programmes. The groups found the voice too "traditional BBC", rather worthy and lacking enthusiasm. In the light of this finding, a different narrator was used for the public-release version, with a more youthful style and slight regional accent.

User Tests

A number of user tests were carried out during development and the results used to shape the application. The tests were informal and consisted simply of sitting a user in front of a PC with minimal guidance, and observing and discussing their use of the application.

Users with computer-gaming experience were found to interact differently from those without. Gamers' interaction was usually characterised by better navigation and much faster movement within the world. As a consequence of their greater speed, gamers tended to explore the entire world but miss the richness of the commentary, and miss some of the

discoveries. It also appeared that they preferred the challenge of discovery of the nominated items, rather than discovery of knowledge.

Non-gamers tended to adopt behaviour more reminiscent of TV viewing. Their control and navigation was often poor which resulted in them finding a discovery or feature and staying with it. The result was a generally poorer exploration of the world as a whole, but with much more detailed narrative of the discoveries and world. They appeared to prefer observation of the world and discovery of information, rather than interaction with the world.

Non-gamers tended to move from location to location until commentary was triggered, and then stop to watch what happened, often removing their hands from the keyboard to do so. Once the commentary ended, these users would respond to prompts in the commentary in order to determine where to go next. The narration could have developed a narrative story line to take advantage of this effect.

Gamers, in contrast were constantly on the move and never stopped to watch or listen for any length of time.

3D virtual environments are notoriously difficult to navigate, and with Simutainment the users, particularly non-gamers, found this to be the case. The users did not have a good sense of where they were or where they were going. This lead to frequent referral to the map screen and disruption of the immersive experience. To assist with navigation, more distinctive visual features were placed in the environment. In addition, a facility was added to the map screen which enables users to turn to face the intended direction of travel without having to return to the first-person exploration view.

Roughly half the adult users said that they would rather watch a TV documentary (like "Walking with Dinosaurs"). TV documentaries offer continuous narration and interest and require little activity by the user. It would appear that the interactivity inherent in Simutainment is not as stimulating or exciting to adult users as hoped.

Children, in contrast, were excited by the interactivity and made comments like, "Cool, I found another dinosaur". They became absorbed in the application; a 10-year old boy played for an hour and younger children from 6-years up played for at least half an hour. They would have liked more dinosaurs.

Audience Feedback

At the time of writing, the application has not been released to the public so no feedback is available. By the time of the IBC 2002 conference, this will be available and will be reported.

CONCLUSION

An example of factual TV documentary content has been successfully converted to interactive, 3D-immersive presentation format on PC. Key elements are a visually stimulating 3D world, carefully designed non-linear narrative, navigational aids, and objectives/rewards to encourage exploration.

Its appeal appears to be greatest with pre-teenage children who become highly absorbed by the interactivity. Adults, in contrast, are less excited by the interactivity and many prefer the idea of sitting back and watching a conventional TV programme.

One day fully-immersive virtual reality will become technologically possible and we need to start thinking about what sort of content will work in that new medium. Games certainly will, and a lot of thought is going into how drama might work (e.g. "Hamlet on the Holodeck"). A similar level of thought is needed to see how factual content might be engagingly presented. One of the aims of Simutainment has been to ask that question (using current technology).

We don't yet have the answers but work like this helps us to see the creative challenges involved.

The application will be available as a free download from: http://www.bbc.co.uk/dinosaurs/

FIGURES

Figure 1 - A view in the desert zone

Figure 2 - The map screen