

Chapter 8

Interactive Television

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Key words: Interactive TV, digital broadcasting, digital television, set-top box, Digital Convergence, BBC Education

Abstract: This paper presents recent experiments in interactive program development done at the BBC. Specific examples using combinations of digital technology and requiring different amounts of bandwidth are reviewed. Lessons learned are shared and various design solutions are presented. The emphasis is on the new thinking required of program developers who must accommodate both linear and nonlinear story lines as well as enriched data content. This is a realistic look at several new program options some of which are possible today and some of which may become possible in the near future. All the programs described were created for the TV broadcast medium, work within the traditional TV program constraint of a set time slot, and are targeted to specific audience segments.

1. INTRODUCTION

Toward the end of 1998, digital television arrives in the UK. It brings the promise of delivering exciting new data services to the home, interactive TV, communication from viewer to viewer and viewer to producer, and most

significantly, a connection to the Internet for every consumer with a television set. The promise is real, but reality is struggling with the growing pains of these new data technologies. Digital Broadcasting immediately offers the consumer a widescreen picture (16x9 aspect ration) and better quality for both picture and sound. The signal is more robust and is not subject to interference from the weather or nearby buildings. No longer will there be snowy pictures or multiple shadows, the picture is either perfect, or not there at all.

The principal effect of changing from analogue to digital is that more bandwidth is made available. This means either many more discrete channels (up to 200 via satellite and 30 via terrestrial and cable systems) or high definition pictures on fewer channels. The UK together with the rest of Europe, has opted for more channels, each channel carries both picture and data information. The picture is delivered by MPEG2 at about 6 Megabits a second and the data at about 2 Megabits a second.

To decode all of this, viewers need a new kind of digital television. At the start everybody will be using a dedicated computer in a 'set-top box' (stb). This not only decodes the pictures but also decodes the additional data stream and adds the potential of a return data path from the user by a domestic telephone line connection. The combination of the television with a computer and the telephone has spawned the term *Digital Convergence*. The combination of television pictures with the other two data streams, is what makes interactive television possible. However it' s use and application is heavily constrained by the capabilities of the stb.

First generation stb's suffer from a variety of limitations: low powered processors, limited memory or disk space for caching data and slow, low bandwidth back channel connections. Designing new services for these means struggling with considerable intellectual, conceptual and practical challenges. It is easier for television producers to look forward to a time when consumers have boxes or dedicated televisions with high powered processors, huge amounts of memory or hard disk space and unlimited bandwidth phone connections. Delivering interactive television to these consumers will be easy.

2. EXAMPLES*

The following examples illustrate some of the work I have been doing within the Digital Media group of BBC Education to explore some of the issues surrounding the production of interactive services using both Digital Television and Internet technologies for both now and the future.

Figure 1. and Figure 2. Fight the Flab

- 1.) *Using the digital remote control, viewers enter personal details about their sex, age, height and weight.*
- 2.) *A special computer program calculates the viewers Body Mass Index, an indication of their state of health and fitness*

Fight the Flab is a day time program designed to encourage viewers to assess their general state of health and fitness. At a variety of points during the program, the viewer is asked to enter personal details about their sex, age, height and weight, using the digital remote control.

Figure 3. Fight the Flab

A special computer program, called an applet, is transmitted as part of the digital signal, alongside the video and audio. Once inside the digital television stb, the computer program performs the necessary calculations that give the viewer their personal 'Body Mass Index' a rough measure of fitness level. The stb also contains a 'Smart Card' which carries the viewer's post-code. Based on this post-code and their Body Mass Index, the applet makes a selection from the contents of a large database that is transmitted along with the television signal. This data is displayed as personalized information on the television screen. All this is possible without the need for a telephone line back channel. This method of creating interactivity using an applet can be applied to all kinds of television programs, from financial reports to quiz shows.

Local Heroes is a popular prime time television series from BBC Education. The presenter Adam Hart Davies visits the homes of engineers and scientists and recreates some of their intriguing inventions. The Interactive version relies on the complete integration of the linear television program, with a very rich Internet web site designed specially for the purpose. The whole package is designed for viewing using a digital stb that offers both a telephone line back channel and a large amount of memory in the form of RAM or Hard Disk.

During the transmission of the television program, the data for the web site is streamed into the set-top box along with the video and audio. The web data stream is about 2 Megabits a second, which allows a rich collection of text, graphics and video to be stored in the memory of the set-top box. The extra information in the web site is classified into four broad categories: Location information, Biographies, Make and Do instructions and miscellaneous information. Initially, we have kept the level of interactivity simple so as not to interfere with the main narrative of the linear television program. Viewers of the Interactive program see four small icons on the

inventions together with instructions on how to make some of them. Table 1 shows the full range of additional material and how it relates to the linear television program. This method of book marking protects the narrative structure of the television program by moving the interactive experiences to after the linear television program has finished. It also protects viewers, who are not experienced Internet users, from *Information Overload*. As they browse through the small number of experiences that they have selected, they are gradually offered deeper access to all of the material available in the stb, together with more current material made available by the telephone line back channel connection to an additional Internet Web Site.

Figure 5. *Come and Join Us*

Come and Join Us is a day time program for 2 – 4 year olds at home with the parents. The program offers a structured learning experience for pre-school children and is actually recorded in a real pre-school, where the stars are the children and their teachers. The linear television program is broken into distinct sections. Each section deals with various types of pre-school activity. In this program, unlike *Local Heroes*, viewers can engage in interactive activities throughout the transmission of the linear program, in 'real time'. At the end of the relevant sections, viewers who have decided to participate in the interaction version, are offered the choice of continuing to view the television program, or to explore the theme further with interactive enhancements. Once in an enhanced area the viewer can engage in activities relating to the program section they have just been watching. Meanwhile the next section of the linear television program will continue in the background for those who have not chosen to engage in the activity, but will not be in vision for those who have.

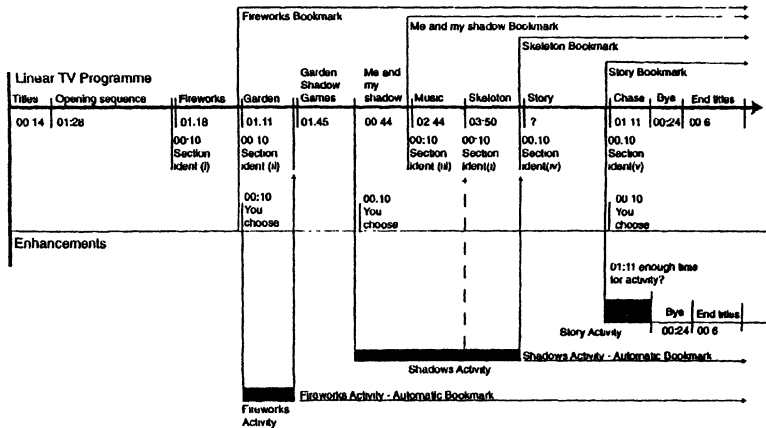
The enhancement activity is designed to last for the duration of the next linear TV sequence. Towards the end, a voice cue warns viewers engaged in the activity that they will be rejoining the television program shortly. The activity automatically ends and Interactive viewers rejoin the television program at the beginning of the next section. This process continues for the length of the program. At any time, viewers can return from an enhancement activity to watching the television program. These 'real time' interactive activities are designed for children to work on with their parents or careers. A bookmark system, similar to that used in *Local Heroes* makes child development and educational material available to the adult viewer after the program.

Designing interactive television programs of this type is very complex. The narrative of the linear television program has to be able to support both

continuous and interrupted viewing experiences at the same time. The structure for a single episode of Come and Join Us is shown in table 2.

Table 2

Nursery Net - Come and Join us. Programme Structure.



The thick black line represents the linear thread of the television program, showing each section, together with their running times. The viewer who chooses to do the Fireworks activity after the Fireworks television section, misses the Garden section of the television program. However, later they return to the television program for a sequence about shadows in the garden. After this they have a choice of another activity that explores some ideas about shadows. If they choose this, they miss two more television sections. They are told about the skeleton section and encouraged to return to the television program at that point, however they can continue with the shadow activity until the beginning of the Story section, where they are forced to return to the television program to hear the story. At the end of the program adults can view their book-marked information and children can continue with their activities.

The activities have been designed for use by children with adults. However because very young children might have difficulty with a digital remote control or mouse, Come and Join Us uses a Concept Keyboard, a children's touch sensitive tablet that replaces the normal infra red digital remote control. The tablet is designed to take paper templates, this provides a cheap easy way of customizing the tablet for every single program.

Figure 6. Concept Keyboard

The templates are published in the magazine format program guides so that they can be cut out and inserted into the tablet for use. In these three case the principal limitation has been the lack of user control over the linear television program. The program is broadcast in the traditional way, it has a beginning, middle and end – in that order, and it starts and stops according to a publish program guide. My final example, *Science Zone Interactive* was designed for broadband network delivery and was funded by the European Union. In this case every viewer is receiving television programs across a network connection, such as a broadband cable system. Programs are available 'On Demand' and not broadcast according to a schedule. When this kind of service is available the viewer can have complete control over the television program, as well as any interactive enhancements. There is a two way connection between the viewer and the delivery system.

These delivery systems are powered by a series of large scale computer servers that can access thousands of hours of digital video data. *Science Zone Interactive* combines this ability to deliver large amounts of video material with the computing power of the system itself. In this way it offers a self restructuring narrative that interacts with the user in real time. It is a unique product and for this reason I have chosen to describe the project in some detail.

3. BBC SCHOOLS PROGRAMS' *SCIENCE ZONE*

This is a series of 24 x 20' broadcast television programs aimed at teaching children aged 9-11 elements of the National Curriculum for England and Wales Primary Science syllabus. The subjects covered range from basic optics, through materials science, to the biology of birth.

Series style *Science Zone* teaches science through a mixture of adventure and explanation. Each program is constructed around a genuine challenge issued to the presenter; they have to find out enough about a particular

aspect of science to help them complete a practical and entertaining real-world feat. To help them with the challenge, the presenter meets various “mentors” in relevant fields. Around this challenge, the programs are split into various different sections, called *Zones*:

- *Demo Zone*: concepts are demonstrated using scientific equipment or specially commissioned models.
- *Data Zone*: lots of interesting facts and statistics about science are presented
- *Micro Zone*: the program looks at science microscopically using various special video techniques.
- *Movie Zone*: mini-documentaries explore different aspects of relevant science in the wider world.

Overall, the programs are rapidly paced and fun; they seek to entertain as well as educate.

Figure 7 a. b. c. Zones

4. LINEAR PROGRAM OUTLINE

Science Zone - Interactive is based on one of the *Science Zone* programs called *It's in the Blood* which teaches aspects of circulation and respiration in the human body. In the program, the presenter is introduced to a class learning first aid. His learning experience within this class sets the framework for the program. In the first part of the program, the presenter has to administer aid in the reconstruction of a small accident, a fall from a ladder with subsequent bleeding and respiration problems. The presenter meets a specialist make-up artist, who explains how “casualties” are “made up” to make accident reconstructions realistic. In describing her work, the viewer learns about the way blood flows around the body.

Interwoven with this, mini-documentaries show how a diver breathes underwater, and how surgeons use virtual reality techniques to perform delicate operations. The viewer also sees endoscope pictures of the heart, demonstrations of how the heart and lungs work, and how blood flows through the body. There are also lots of fascinating facts about the human body.

In the final part of the program, the presenter unsuspectingly finds himself part of a major accident training exercise, involving 60 casualties and a ferry on fire on a lake. The program follows the presenter as he uses his newly learnt skills at first aid in treating the “injuries”. The viewer also sees the emergency services (police, ambulance, fire, helicopter rescue) as they race to the scene and rehearse their accident techniques.

5. INTERACTIVE PROGRAM OUTLINE

The interactive version of *Its in the Blood* explores ideas of learning through **narrative** in an interactive environment, rather than ideas of research through the use of an interactive **encyclopedia**. The broadcast linear version is used as the starting point for the interactive version. Once the viewer starts interacting with the program, there are ample opportunities to explore, before rejoining the main narrative thread again.

The interactive version has been designed to be a very engaging, immersive experience which can be re-visited many times, unlike a linear program which is designed for a few viewings only.

The following are the general guidelines for the interactive design of *Science Zone - Interactive*:

- It has the **look and feel** of a television program, rather than a computer program. In particular, the default way of viewing the program is with the video running full-screen and uncluttered by any buttons
- Like linear television, *Science Zone Interactive* has the feel of a **continuous** medium, rather than an interruptible medium. In particular, there are very few points where the program stops and waits for user input.
- The viewer is **encouraged** to make interactive choices, rather than forced to do so.
- The target viewers are particularly receptive to interactive techniques from the world of computer **games**, rather than the ideas found in computer programs designed for use in an office environment.

6. INTERACTIVE ZONES

Science Zone - Interactive offers an interactive environment that the viewers can explore. The different zones in the linear program are represented by different zones in this interactive world, each with its own style of interaction.

We have used *Science Zone - Interactive* to investigate different styles of interaction and their application to designing Interactive Television Programs:

- Different versions of linear narrative: By taking advantage of “junctions” in the program where interactive menus occur, different viewers are able to take different narrative routes through the program material.

Interactive Zones

Science Zone - Interactive offers an interactive environment that the viewers can explore. The different zones in the linear programme are represented by different zones in this interactive world, each with its own style of interaction.

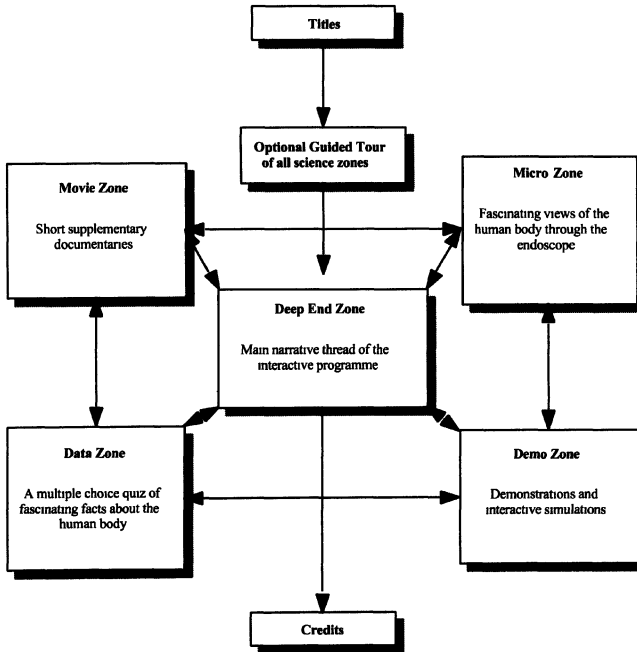


Figure 8. Interactive Zones

- Different levels of explanation: We have used interactivity to allow different viewers to get different depths of explanation of the science of respiration and circulation. We see this as an enormous advantage of interactive television, where each pupil will get individually tailored teaching of the subject.
- Different points of view of the same event (parallel story lines): This is an activity that allows viewers to see different points of view of the same situation. In a major accident reconstruction at the end of the program, viewers can choose to see the story from the point of view of the following participants: the presenter, a medical doctor, different ambulance crews, a fire brigade crew, the helicopter rescue team. At

various points, as different people's stories interweave, the viewer can choose to leave one set of people and continue watching the event from another point of view.

- Intelligent Management System (IMS): We have devised a Resonant Interactive System in the form of an Intelligent Management Systems which takes control over the various interactive styles. The IMS builds a profile of the user whilst they are watching the program. The IMS then 're-cuts' the main narrative according to this profile, without the user being aware. This is an example of automatic resonance, the highest level of interactivity. We see this as being particularly important in the design of future interactive television programs.

The design of the navigation around the interactive program is based on the principle that users will need to navigate **globally** around the *Science Zone* world and **locally** within particular interactive modules.

Another fundamental feature of the interface is the use of **filmstrips** containing strips of frames to represent different sequences. Viewers can use these filmstrips to elegantly fast forward or rewind through sequences.

7. GLOBAL NAVIGATION

In *Science Zone* Interactive, the user can navigate globally around the entire world of interactive modules using a 3D map. The style of this map has been carefully designed around the visual style of the *Science Zone* series. Viewers can look at the map to see the layout of all the interactive modules. In this view, the central line of rectangular blocks represent the different sections of the *Deep End* zone; the discs represent modules in other zones, and is color coded. Each rectangle and disc has a representative picture on it. Viewers can "zoom in" on this map to see one set of modules in greater detail.

Figure 9. and Figure 10. Global Navigation

Figure 11. close detail

Viewers can turn the view from left to right to see modules in close detail

Figure 12. view of the map

Teachers and other adults can use this view of the map to disable particular modules which they may not want certain students to explore.

Figure 13. an interactive module

At any time reviewers can bring up a filmstrip representing an interactive module, and can then click on a frame in the strip to jump directly to a point in the interactive module

8. LOCAL NAVIGATION

It is anticipated that viewers will only use the 3D map to navigate to a particular point in the program. Most of the time they will be watching full-screen video from one of the interactive modules. When an interactive choice becomes available within the module, the viewer sees a representation of the choice appear towards the edge of the screen. To take the choice, the viewer simply clicks on the screen in the appropriate place. The current interactive module continues to show, and if the user makes no choice the extra option will disappear when it is no longer relevant.

Figure 14. Demo Zone

Here the user is watching a "Demo Zone" about the mouth and throat. A Color coded option has just appeared on the left of the screen to indicate that another option is available - demonstration of how the body works Note the "channel indent" in the top left of the screen to identify which zone the user is currently in

Figure 15. Movie Zone

The viewer continues to watch the demo zone, and a little while later a second option appears, which gives the option of watching a "movie zone" film about divers.

Figure 16. Diver documentary

The user clicks on the small picture of the diver and the image zooms to fill the screen, and then starts playing the diver documentary.

Figure 17. red button

The red button in the bottom left of screen allows the viewer to bring up the filmstrip, which allows an elegant "rewind" to any sequence the viewers has already seen.

Interactive Storyboard

There are many cross-references between the different zones, as detailed in the table below.

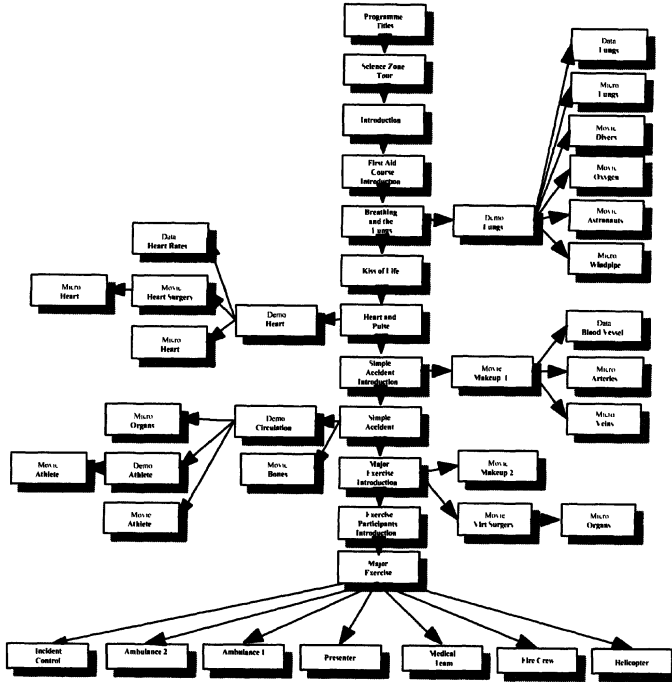


Figure 18. Links between different zones

9. INTERACTIVE STORYBOARD

There are many cross-references between the different zones, as detailed in the table below. The principal viewing experience follows a main narrative backbone, which is represented by the central column, moving from Program Titles through the Introduction and all of the components until the Major Incident. At all times the Intelligent Management System is monitoring the viewers activities; do they branch of the main narrative? How far into a branch do they go? How long do they stay there? This information

is then used to 're cut' the main narrative for the viewer, in real time. If a viewer spends a lot of time in one or more of the zones, exploring extreme detail about the lungs, they will not expect yet more detail on the lungs in the main narrative. The Intelligent Management System makes continuous changes to the main narrative to accommodate this. The overall story is always the same; the narrative path that each viewer takes along the story is different.

In the final part of *Science Zone Interactive*, viewers can explore the interactive story of the presenter as he is thrown in the *very* deep end at a major accident reconstruction. The viewers can follow this story from seven points of view.

We travel with the presenter as he arrives unsuspectingly at the scene of the major accident exercise

Each of the seven characters participating in the exercise is introduced. A map of the area where the exercise is taking place is also presented.

Figure 19. The presenter

Figure 21. A female ambulance crew member

Figure 23. Incident control officer

Figure 25. The medical team of doctors and nurses

Figure 27. Exercise Participants Introduction emergency

Figure 20. A male crew member

Figure 22. The emergency services

Figure 24. A fire crew

Figure 26. A birds-eye view from helicopter

Figure 28. Viewer chooses a single person to follow

As their story unfolds all seven stories are running in parallel. The viewer can jump forward or backward in time, using the film strip control. All the stories will move together in synchronization. The viewer can move from one story to another by returning to a story menu, however two or more stories often intersect, giving the viewer an opportunity to immediately jump from one to the other. The program also includes a variety of software-generated simulations and experiments. The total viewing time for *Science Zone Interactive* varies between twenty-five and one hundred minutes. The overall experience is built from a total of four hours of video material.

10. INTERESTING ISSUES THAT NEED ADDRESSING

Unfortunately it is likely to be some time before wide bandwidth services are available to consumers, and so *Science Zone Interactive* will have to wait before it gets a wide viewership. In the meantime our experience in producing interactive television programs for delivery over existing

analogue and new digital television networks, has raised many interesting issues that need addressing.

- We need to develop new interface metaphors. We need to move away from the desktop and the notion of search and research that has become synonymous with computers and the World Wide Web. After all, you need to know that you don't know something before you can search for it! In very general terms, television is a medium of entertainment and discovery. To be attractive to the majority of consumers we may need to develop discovery engines rather than search engines.
- We need to revisit screen design and how we integrate a web experience with a television experience. We are already seeing the establishment of a format that shrinks the television picture and puts it in the upper left of the television screen, the remaining L shaped space being filled with web orientated experiences. Already the stb's will do better than this! They offer dynamic scaling, translucence and overlay facilities. It's time to start using them.
- We need to consider the home viewing experience. Different designs are needed for family viewing groups in the living room and single users in their dens.

We also need to explore new narrative structures, ones that sustain and encourage interruption. Having said that, my current work is based around taking interactive experiences out of the television and into consumer computers, tablet PC's that everybody will have in a few years. This uses the digital data stream as a conduit for interactive experiences. Digital convergence is growing up, what we are beginning to see is a convergence of concepts and a divergence of delivery systems, digital *divergence* rather than *digital convergence*.

When discussing this I often hear people say "But do we really want a PC in our living rooms?" The answer is probably not, but that is not what interactive digital television gives us. What it does give us, is a totally new kind of television set, and what we want, are totally new kinds of television programs to show on it.

* Figures with color plates follow the chapter

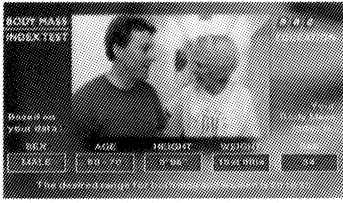


Fig.1

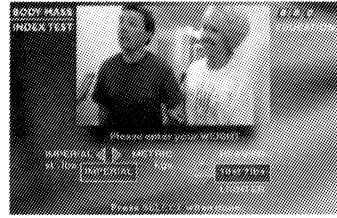


Fig.2

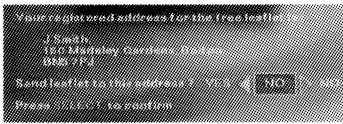


Fig.3



Fig.4

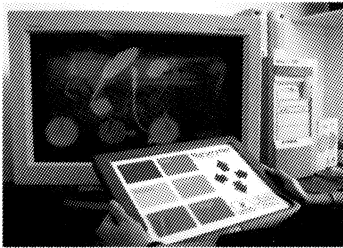


Fig.5

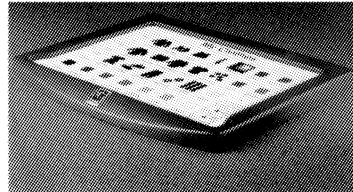


Fig.6

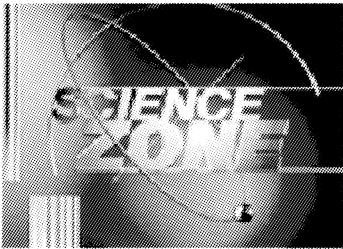


Fig.7a

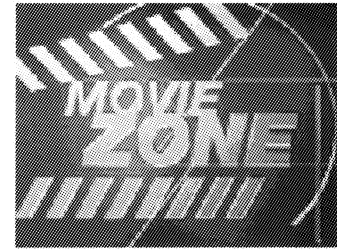


Fig.7b

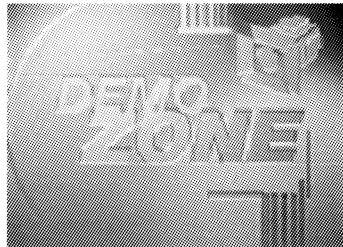


Fig.7c

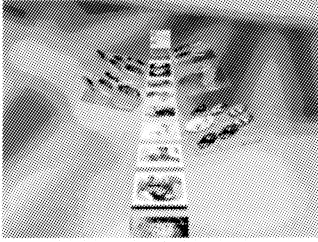


Fig.9

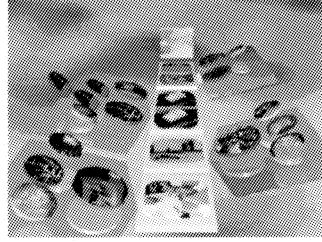


Fig.10

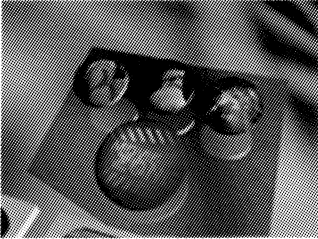


Fig.11

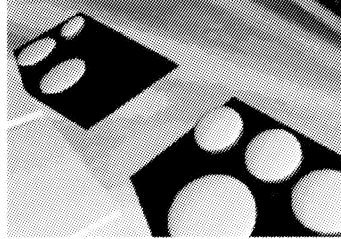


Fig.12



Fig.13

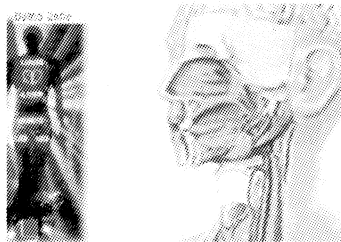


Fig.14

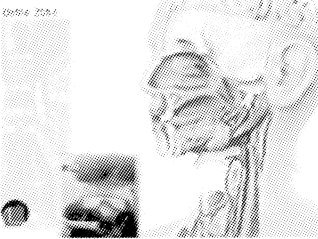


Fig.15



Fig.16



Fig.17



Fig.19



Fig.20



Fig.21



Fig.22



Fig.23



Fig.24



Fig.25



Fig.26

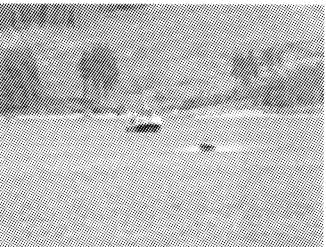


Fig.27



Fig.28

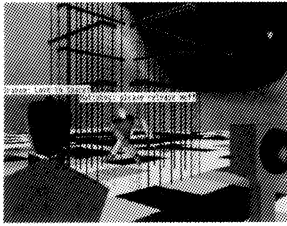


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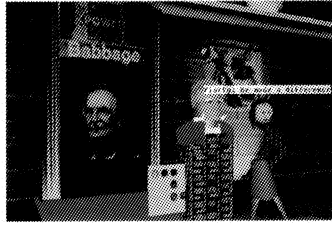


Fig.3

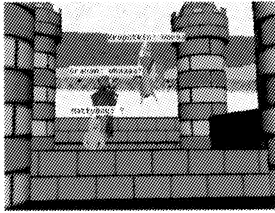


Fig.4

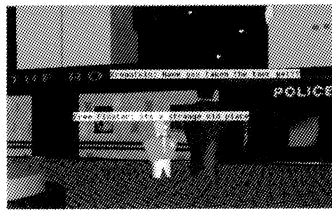


Fig.5



Fig.6



Fig.7



Fig.11

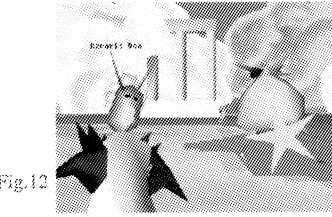


Fig.12



Fig.13

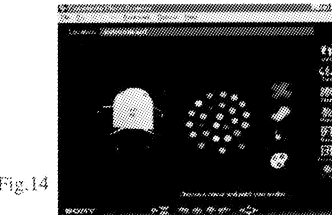


Fig.14

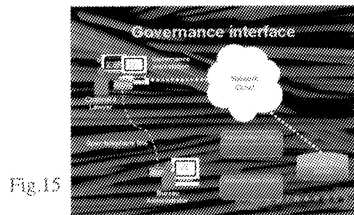


Fig.15