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Research on 3D Interactive Platforms at BBC R&D

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Abstract

This paper reviews the BBC's main areas of research interest within the domain of 3D interactive platforms: open platforms, new interfaces, and new content. It is based on a short paper that was given at the Games Design and Technology Workshop 2005, Liverpool.

INDEX TERMS: *Games, user interface, content, somatics, neuro-linguistic programming*

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Research on 3D Interactive Platforms at BBC R&D

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1 Introduction

This short paper gives an overview of the BBC R&D department's main areas of research interest within the domain of 3D interactive (games) platforms. Some of the discussion involves work-in-progress, and much of it involves work yet to be started. The general idea of the paper is to provoke both technical and artistic thoughts and ideas. Hence, the level of technical detail is minimised in favour of discussions of general concepts.

We begin, in section 2, with a discussion of the motivation behind this research. This is followed by discussions of our three main areas of interest: open platforms in section 3, where we are looking at how to get content onto 3D interactive platforms; new interfaces in section 4, where we are looking at developing new technology to allow for much richer and more natural interactions; and new content in section 5, where we are looking at the content authoring process.

2 Motivation

One of the primary goals for the BBC is to reach and serve the **entire** British audience: BBC output must be of relevance to all, and minority groups must be reached in ways which are appropriate for their lifestyle. For example, museum regulars could be reached by placing BBC 'content' into museums.

A growing group that are seen by many to be under-served by the BBC, are computer game enthusiasts. This group tend to feel that their game platform is the primary platform for relaxation and entertainment, rather than their TV. To many of these people, the BBC are insignificant, if not irrelevant. The BBC needs to work on reaching this audience sector in new ways.

One way to reach this audience is to provide content for their platforms of choice, using the content grammars that are familiar to them. However, the BBC cannot simply publish free-to-air computer games which compete with commercial games. This would break our code of ethics (by using the licence-fee to compete with commercial organisations in the open market), it would not achieve the BBC's overall social objectives, and it would not be economically sustainable. The BBC needs to produce new types of content for these platforms which we generalise and differentiate from current games genres, referring to it as '3D Interactive', rather than simply 'Games'. This presents the BBC with an opportunity to reach its audience in new and exciting ways, through a new type of content.

This new type of content must:

1. be freely available to all;
2. require budgets on a similar scale as TV productions, rather than Hollywood blockbusters;
3. be innovative;
4. bring the BBC trademarks of high quality narrative, impartial information, and accessible education.

These requirements are clearly non-trivial and cannot be achieved without a substantial investment in research and innovation in those areas which are not covered by commercial R&D operations. Generally, we have observed that the open market is upholding a significant on-going development in graphics and general-purpose processing, and to a lesser extent, in audio rendering technologies.

Three very important areas which are required to support our above objectives remain quite weak: **open platforms**, **user interfaces**, and **content**. These are the areas in which we need to focus our research and innovation activities, and they are discussed in more detail in the following three sections.

3 Open Platforms

This topic is primarily aimed at achieving the first of the above goals: ‘freely available’. It has been the focus of BBC R&D’s work to date on 3D interactive platforms. We started looking at this topic in 1996, when we explored the possibility of maintaining 3D assets (used for TV production) in their native 3D form all the way through the programme chain to the viewer - relying on the viewer’s home platform to perform the final render. We teamed-up with 7 academic and industrial partners on a 3 year collaborative project known as PROMETHEUS [1], within the UK Government Department of Trade and Industry’s LINK programme. The aim of the project was to prove the feasibility of an end-to-end 3D programme chain, from content production, through delivery, to fatigue-free 3D display[1], using open standards where appropriate.

The project concluded in September 2002 [2]. The point of the project was to exploit both the computational and networking capabilities of the future home platform. As the project progressed, we became increasingly aware that games platforms were ideally suited for playing out the PROMETHEUS content. Unfortunately, the design of the system did not consider the key feature of all content consumed on these systems: **interactivity**. Who wants to use a game platform to display 3D content with no interactivity?

We have since been developing a PC-based, open source 3D interactive engine, as a proof-of-concept to explore possible paradigms for BBC 3D interactive content. The engine, known as the ‘3D Interactive Media Lounge’ (3DIML) [3], is a multi-user application based on the open source ‘Crystal Space 3D’ game SDK [4]. It has functionality to stream linear content, such as TV and music, as embedded assets within the 3D interactive world. The idea is that it can be used in a similar way to online games like ‘Second Life’ [5], to remotely share the media (eg TV) experience with distant friends and family. Ideas around this are discussed further in [6].

We shall continue to use and further develop the 3D Interactive Media Lounge in our ongoing research. We also plan to release a future version of it to the public in a more accessible form, for all platforms.

4 New Interfaces

There is a general feeling that user-interface is one of the limiting factors in all human-machine communications, but this especially applies to 3D Interactive. Current user interface technology is limited in terms of bandwidth (ie the amount of information that can be communicated at any point in time), usability, and often health and safety. We hypothesise that this is down to the ad-hoc way in which user interface technology has evolved, being designed to suit the needs of the machine rather than the user. Taking a longer term perspective, we need a more sustainable, user-orientated approach to the problem of user-interface. This translates into the following requirements:

- Maximise efficiency of use.
- Minimise fatigue from use - should preferably have zero fatigue, and definitely have zero injury (eg RSI).
- Usable by all, regardless of age or ability, (or species).
- Natural - unencumbered, simple, and obvious to use, perhaps even therapeutic.

4.1 Interfacing the Human Body

The objective of any user interface is essentially to provide a means for the user to communicate with the machine. More specifically: to facilitate communication between the **mind** of the user and the machine, normally via the **body** of the user. In this context, we consider user interface to be a two-way communication (hence input and display) between mind and machine. In normal everyday thinking, the body is perceived to be such a strong barrier between mind and machine that the connection between mind and machine is not even acknowledged. However, this ‘dualist’ philosophy regarding the mind

[1]Most 3D displays use ‘stereo’ techniques, which are known to cause considerable fatigue. This is believed to be mainly due to the focal depth being generally non-coincident with the convergence depth.

is obsolete and it is widely accepted that the mind and the body are actually two parts of the same system. Reframing in these terms situates the problem of user interface within the domain of 'mind-body consciousness'.

Perhaps the most important body of knowledge we can draw upon for this is 'Somatics' [7]. Somatics, which is founded on the premise that the mind and the body are two parts of the same system, is defined as the field of study dealing with somatic phenomena: the human being as experienced by herself from the inside. This rather vague definition gives weight to the fact that any subject dealing with mind-body consciousness is by its very nature, difficult to define in a conventionally scientific way. Hence, rather than dwelling on scientific definition, the subject is considered by means of example: as it encompasses yoga, pilates, taichi, qigong, Alexander technique, Feldenkrais, etc. Generally, the various somatics **practices** are concerned with health and wellbeing, through complete mindfulness of body posture and motion. For the purposes of technology research and development, we focus on the practise rather than the philosophy.

The application of somatics to interface development is not a completely new idea. Our inspiration originates from the works of artists such as Thecla Schiphorst in her work on wearable interfaces [8]. So, how can **we** apply these theories and techniques to development of new interfaces?

For our study, we are particularly interested in input devices. This is because they enforce the most limiting constraints in the mind-machine communication process, and seem to be lagging behind display devices in terms of technological development. We want to develop devices with a higher information throughput, and which allow the user to communicate more naturally with the platform and/or content, and vice versa. Most importantly, we want to be sure that the input device enhances, rather than distorts, the perception of the content.

Ideally, the only element of the system which influences the user's mind should be the content itself. The producer wants to create feelings of excitement, anger, frustration, sorrow, elation, etc, embodied in the content, and output via the display devices. With the somatics approach, we would ensure that the body posture and movement has a positive influence. The design would need to be structured so that the participant is guided through their physical interactions into body states, and hence mind states, that are congruent with the content. The use of the term 'body state' is quite specific here. It refers to position; posture; tensions throughout the muscles, ligaments, and joints; and motions.

The amount and range of physical movements and postures required for this implies that the user should not be seated. Galen Cranz, with her somatics approach to architecture, concluded that sitting down in a chair is fundamentally unnatural. Yet we are socially conditioned from birth into being seated in chairs of various types for most of our lives [9]. For example, picture the gamer, exploring some virtual territory. The participant might be perched on the edge of the sofa, gamepad in hand, the head moved forwards in front of the torso, neck stretched forwards, the shoulders hunched-up, bodyweight concentrated into the lower back. The participant's body state is a result of a complex mixture of influences.

The strongest influence is probably the content itself. Second, or perhaps equal to this, is the furniture upon which the participant is sitting. The input device does not force the participant to be seated, rather this is just the position that is habitually chosen. We hypothesise that by self-imposing limitations in appropriate body state, the participant is unknowingly imposing limitations in mind state, and hence distortions upon their perception of the content. What would the participant's body state be like if there was nowhere to sit?

Even if the participant's perception of the content in the above scenario is shown to be relatively undistorted, the posture described has some rather unhealthy elements to it. Simply being seated on a sofa is a potential health and safety issue, due to the stresses that the resulting posture places upon the spine [9], which can lead to headaches, digestive problems, high blood pressure, etc. However, health and safety aside, our hypothesis is that the participant's mind state and hence level of involvement, can be greatly enhanced by our somatics approach to interface design. A good example of an interface which demonstrates this is the dance mat - you cannot play unless you get up and dance, there is a heightened physical involvement, the device seems tightly coupled with the content, and the result is very compelling.

Somatics practise tells us that the machine interface and display are both integral parts of the user's immediate environment, and that the user's senses interact with the environment as a whole. Hence, the human senses are the body's connection (interface) with the environment. The information from

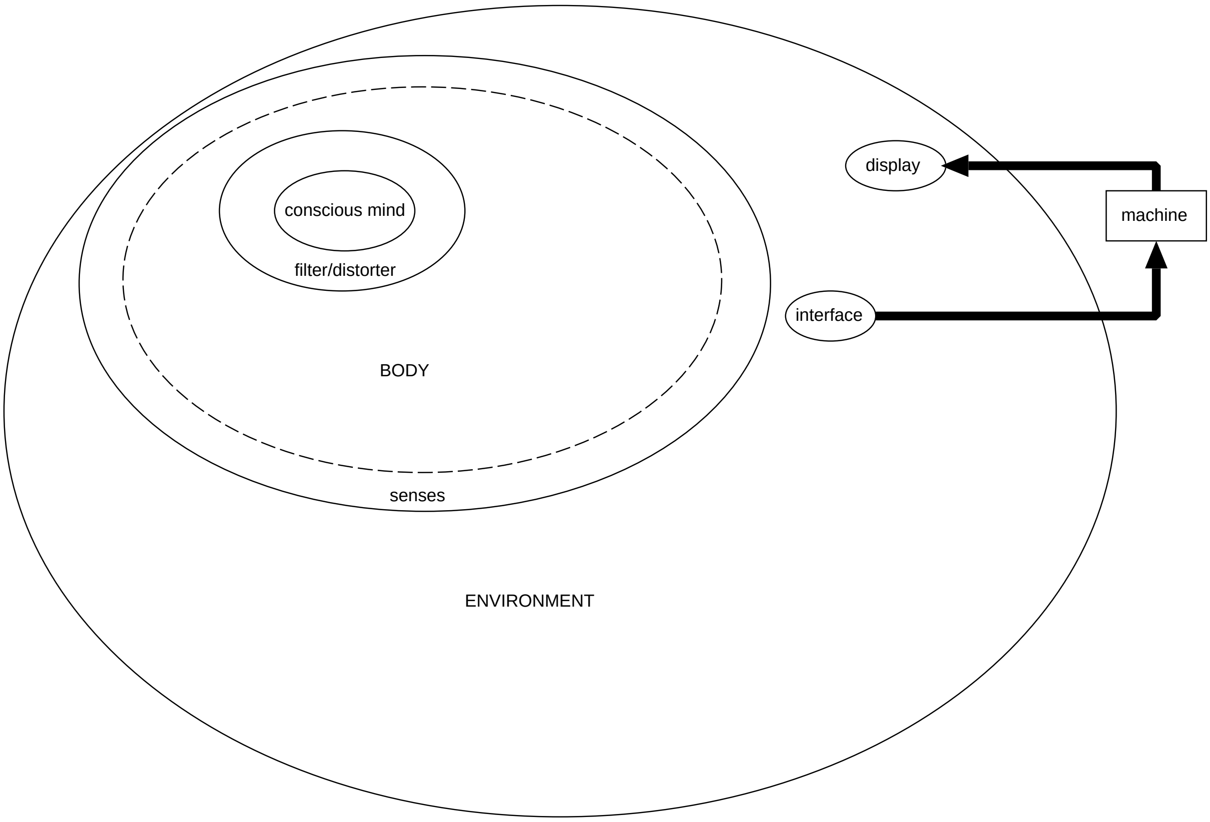

Figure 1: Map of the Human Machine Interface Process

the senses is filtered and distorted as it passes through the body. The conscious mind then builds its perceptual model of the environment based on the resulting information. Figure 1 shows a simplified map of this.

In engineering terms, somatics allows us to apply control theory to the problem of user interface. The body is the observation of the user's state. Somatics gives us the meaning of that observation - ie the relationship between the observation and the user's state. Hence, with somatics we can estimate the state of the user based on the observation, and we can use that estimate directly as the input to the machine. Figure 2 gives a schematic representation of a generic human-machine interface situation, making use of this control theory approach. The diagram shows all of the components within the system (at a high level of detail). The conscious mind, the filter/distorter, and the senses are shown as separate elements of the body, however, in reality they are integrated and hence strongly influence one another. For example, the senses play a large part in the interaction, such as with a mouse, there is a combined tactile and visual influence. The schematic gives us the opportunity to use control theory in our practical approach,

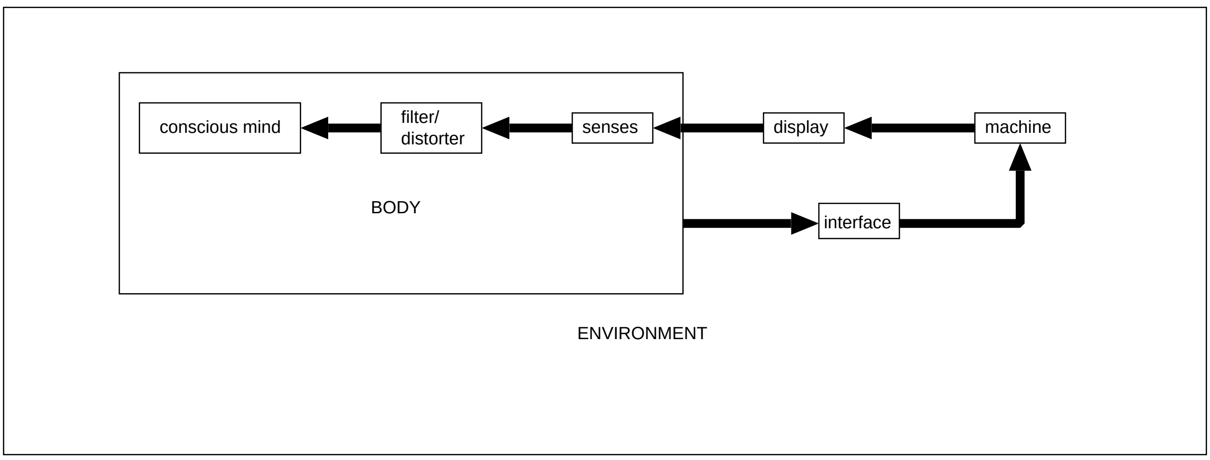

Figure 2: Human Machine Interface Schematic

provided we bare in mind the limitations it imposes.

4.2 Inclusion

Usability leads us to the very important topic of inclusion and accessibility: the user interface should be usable by all. Commercial devices have tended to focus on the fully ‘able-bodied’ participant. The ‘gamepad’ style device is not highly exclusive, as you do not need to be able to stand in order to use it. Nevertheless, it still excludes people who have difficulty in coordinating the movements in their arms and hands, or those who do not have use of arms and/or hands.

In our work on the ‘TRUST’ project [10], we experimented with the use of four ‘joystick’ style game controllers for game input. The controllers worked in parallel. The participant only needed to be able to fully operate one of the controllers in order to perform all available interactions. However, having four operating in parallel allowed the participant to use more than one at the same time. If the participant did not have full movement in any of her limbs, then she could augment her preferred controller with any (or all) of the other three controllers to achieve full game control.

The TRUST installation gave the children a great deal of flexibility in how they physically achieve the interactions within the game, and our test subjects were delighted and intrigued with the result. However, it still fell short of a practical inclusive interface, because it did not provide for those people who were unable to use any of their limbs.

As discussed in 4.1, we want to encourage the participant out of the seat, which would seem to be making matters worse in respect of inclusion. However, we consider inclusion as a part of our overall development strategy from the outset - if the participant is not seated, it does not necessarily mean that they are standing. One highly inclusive possibility is lying down. In our research on this, we would like to explore the use of floatation [11] as the support for the non-seated body, in combination with adaptive linguistic[2] interface, making use of a range of inclusive body observations such as heart-rate, skin conductivity, EEG, facial tonality, etc, together with the more obvious modalities of limb and digit motion, and existing interfaces used by people who are unable to use their limbs.

5 New Content

When it comes to content, the ‘BBC’ label brings about a certain expectation in the user - what is termed here as the ‘BBC standard’. People expect a certain level of technical quality, and also a certain ‘look and feel’ to the artistic quality. The BBC standard includes rich narrative, accurate information, and reliable education.

We need to understand how to ensure the BBC standard remains consistent across all new (and old) platforms. We also need to understand what it is the BBC can add to new platforms which is not already available from other sources. For any interactive platform, the cost-effective ‘rich narrative’ nut remains to be cracked. A longer term research investment in appropriate AI techniques is the technical way forwards. However, there has to be an artistic way forwards to complement this.

A promising body of knowledge we can draw upon is ‘Neuro Linguistic Programming’ (NLP) [12]. This is an empirical set of tools which are used for effective communication. Essentially, it looks at the human process of communication from a behavioural/linguistic perspective, and is primarily used in Sales, Business Management, Education, and Psychotherapy.

To date, we have seen very little application of NLP within the domain of interactive content. Mel Slater and Martin Usoh applied some of the basic NLP knowledge to the problem of measuring ‘presence’ in Virtual Reality systems [13]. However, we would like to apply it to the artistic process - to the content and its creation. For this, we can draw upon the main NLP tools such as rapport, body language (cross-over with somatics), presuppositions, anchoring, reframing, submodalities, etc. Indeed, we see many examples of its use (intentionally or otherwise) in linear content.

Consider an example of a future 3D interactive news application. Each user has a ‘virtual news reader’, an artificial character who, rather than telling you news stories, discusses them with you. In the process, it makes use of NLP techniques to build-up a good relationship with the user, and the user

[2] Body-language is a major element of this.

develops a feeling of affinity towards it. The user wants to discuss the news with this character and they enjoy the experience of being informed about current affairs.

For our initial research in the use of NLP for 3D interactive content, we shall collaborate with artists to produce experimental artworks that explore these ideas.

6 Summary

This paper described BBC R&D's three main areas of on-going research in 3D interactive platforms: open platforms, where we are looking at how to get content onto 3D interactive platforms; new interfaces, where we are looking at developing new technology to allow for much richer and more natural interactions; and new content, where we are looking at the content authoring process. To date, we have focused our efforts on the first of these three areas. We are now looking at starting activities in the latter two areas.

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