

Integrating internet and digital video broadcast data¹

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ABSTRACT

The form, and means of delivery, of digital multimedia content are developing rapidly. This paper outlines our approach to exploiting these developments through the integration of broadcast and internet technology. We discuss the technological developments which underpin the convergence of broadcast and internet, the novel services and applications it enables and the challenges it presents for user-interface design.

1. Introduction

The advent of digital TV is producing a plethora of new, innovative interactive multimedia services, where broadcast and interactive (e.g. Internet) applications are starting to converge. A previous project, CustomTV [2], explored some ways in which MPEG-4 could be used to add interactivity to broadcasting. To be accepted by the user, these new services need to be designed so that they can be easily managed and readily and comfortably accessed. Two of the main objectives of the SAMBITS project are:

- To develop Multimedia Studio Technology for off-line and real-time design of new interactive multimedia services containing MPEG-4 [3] and MPEG-7 [6] elements allowing for more interactivity (local and remote).
- To develop Multimedia Terminal Technology for access to these new interactive multimedia services. This is done through integrated broadcast and Internet reception at the home and a return-channel through the Internet, allowing for personalised additional information.

We are concerned with the second objective. Our aim is to develop a real-time consumer-type terminal prototype, which allows the demonstration and evaluation of integrated digital video broadcast and internet services, including local and remote interactivity. The terminal will provide the user with access to high quality digital video, as provided by DVB, and to the vast worldwide collection of interactive services and databases on the Internet at the same time. The particular parts of this development that we are undertaking are the information retrieval [1], user interface elements, and the terminal structure.

ISO MPEG and DVB technology has been chosen as the cornerstone technology for designing the terminal system. The technical innovation over existing multimedia terminals with DVB and Internet access will be the introduction of MPEG-4 and MPEG-7 functionalities. MPEG-4 provides the means of coding and

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combining selectable arbitrary shaped video objects and Natural/Synthetic 2D and 3D objects. For the user MPEG-4 provides means to interact with this content. MPEG-7 will provide the means for describing (MPEG-2 and MPEG-4) content with metadata. Unlike the preceding MPEG standards (MPEG-1, MPEG-2, MPEG-4) which have mainly addressed coded representation of audio-visual content, MPEG-7 focuses on representing information about the content, not the content itself. MPEG-7 will thus add the functionality to filter transmitted multimedia content automatically and to search for multimedia as well as internet content on request according to the user's profile and preferences. The user will be able to make interactive choices and manipulations by selecting 2D or 3D MPEG-4 objects or by entering textual responses.

2. Information retrieval

To reduce the cognitive overload imposed on end-users by the constantly increasing amount of broadcast and web documents data, we will provide a focussed search to ensure minimum cognitive overload. Studies in information retrieval show that combining querying and browsing accesses to information helps users find what they are looking for. In previous work, we successfully developed a model for focussed search [4]. We will use the same approach to provide a focussed search for advanced multimedia data, which will be based on the navigational engine (see below) developed specifically for the various SAMBITS scenarios. The search engine will be based on HySpirit [5], an experimental platform at QMW for investigating the indexing and retrieval of information. HySpirit is an open platform that has as its core an uncertain inference engine for carrying out retrieval experiments with giga-bytes of heterogeneous data (e.g. structured documents, multimedia data). It can, then, be used to generate, with minimal effort, as many experiments as is necessary to evaluate advanced retrieval models dealing with fact, content, and structure, and is therefore well suited to manipulating MPEG-7 and web data.

All the experimental work regarding the effectiveness and efficiency of the search engine will be carried out on the HySpirit platform. For integrating the search engine in the terminal, only the components necessary for searching the data will be implemented.

We will evaluate the effectiveness of our approach using standard information retrieval evaluation methods. We will build a test collection with relevance assessments (setting a number of predefined queries, and data relevant to them). Recall and precision will be used to measure the effectiveness of the approach.

3. User Interface

A user-friendly interface will be developed to assure easy access and control capabilities. This will be based on two key elements: a navigation engine and a user profile manager which, together with the player control functions, will be accessed via a user interface management layer. The user interface will aim to integrate interaction across different media; e.g., 3D, MPEG-4 objects, URLs and Metadata and 2D broadcast content providing a consistent model of objects and actions for the user.

A systematic task analysis will be carried out on the demonstrator scenarios to determine the scope and complexity of user interaction with the demonstrator system. In particular, the types of text based, 2D, 3D and Internet interaction required for the broadcast content and the scope of return channel information will be investigated. This analysis will form the basis of a requirements specification for the user interface. The user interface design activity will focus on providing, within the context of the demonstrator scenarios, integration of the MPEG-2 player, MPEG-4 player and web browser functions that is as far as possible transparent to the user. This will involve developing an interaction model that will promote consistency of interaction including; navigation, selection, input mode, current focus and feedback and consistency of presentation including; menu bar, buttons, events, grouping and callouts. Changes in the system architecture and feedback from the evaluations will drive several iterations of the user interface.

The objective of the navigation engine is to develop and implement a framework that can be used to support user navigation between heterogeneous information structures, supporting current location and

paths to and from the current position. This will aim to support a variety of possible information seeking tasks, selected on the basis of the scenarios including browsing, directed search comparison, and exploration. This will involve the integration of the interface to the search engine, relevant user profile and preference information, and user interface functions presented to the user. It will also address the issue of maintaining context and managing interrupts and re-entry, and sequencing while switching between primary broadcast content and various hybrid 'sub programmes' and Internet content provided on a narrowcast basis. This activity will also attend to the design of user profile information and preferences and their integration with the MPEG-7 categories. The interaction model will also address the presentation of different levels of interaction - passive viewing, hot areas, 3D manipulation.

The user profile manager will provide each user with an interface for editing and updating their preference information. For example, their preferred programme categories, language preferences and display preferences. In particular, it will provide a simple interface for interacting with the MPEG-7 metadata, managing their choice of events and the types of MPEG-7 information they utilise.

The developing user interface design will be analysed through iterative, formative, evaluations, using heuristic evaluation and system walkthroughs [7]. This will be used to identify major usability issues early in the development process and allow for redesign of the user interface accordingly. The prototype will be tested more extensively through presentation to a panel of representative residential users. Reactions will be assessed through a questionnaire study. User interaction with the final demonstrator system will also be evaluated at the end of the project through controlled evaluations.

4. The Terminal Structure

The terminal will make use of commercially available elements wherever possible. The basic structure is shown in Figure 1.

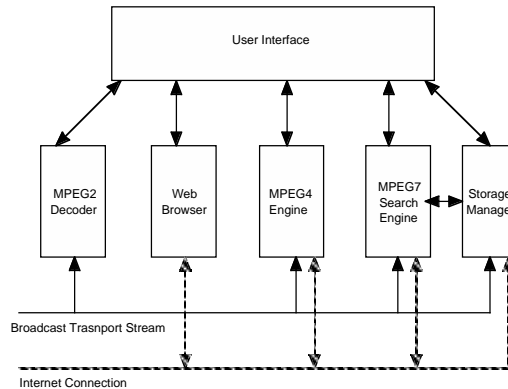


Figure 1 The terminal structure

In practice the equipment would be a set-top box, but for the purposes of development we are using a PC as the basis of the terminal. The MPEG2 decoder is hardware (a standard card) while the other elements are software. The MPEG-4 engine has to perform MPEG-4 decoding and compositing. As this requires considerable computer resource the PC must be a high performance model with multiple processors. This limitation would not be present in future systems as MPEG-4 hardware components are being developed.

5. Conclusion

The development of a user terminal in the SAMBITS project allows user acceptance of new ways of combining television and the Internet to be explored. The MPEG-4 standard and the emerging MPEG-7

standard offer new facilities for multimedia data. An important facility is the ability to search for content based on metadata descriptors.

Efficient content selection from the explosion of broadcast information that digital broadcasting and related web content provides is a challenging task. This project is attempting to develop new search techniques and effective user interfaces so that filtering the mass of available information is a task that will be within the competence of the ordinary viewer.

5. References

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