An integrated framework for personalized t-learning

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EXECUTIVE SUMMARY

Broadcasting interactive learning applications through the digital TV promises to open new pedagogical perspectives given the wide penetration of the medium. This case deals with an open, flexible learning oriented technological framework for interactive digital TV. The framework is divided into two main parts: the production side, where the course is created and the client side, where it is presented on iDTV through an interactive learning environment. The course production is supported by an ad-hoc designed authoring tool, which has been thought for a use by pedagogical experts, while the runtime user interaction on iDTV is managed by a Course Multimedia Player. Experimental t-learning courses were created by pedagogical experts and served as an important test and evaluation bench for the framework.

ORGANIZATION BACKGROUND

Television has had a long history of performing an educational function for the mass audience, broadcasting edutainment, documentaries and news as well as educational programmes. The arrival of interactive television has the potential to expand the power of the medium by providing interactive learning opportunites. TV-based interactive education promises a huge potential due to its ability to support interactivity while compensating for the

low penetration of Internet-enabled computers in comparison with the penetration of a TV in a household. “T-learning” was the new term, which introduced for the definition of TV-based interactive learning (Aarreniemi-Jokipelto, 2005).
In this section we will present the history of television as an educational medium and the technologies of the digital interactive TV (iDTV). Subsequently, in the next chapters the methodology for designing t-learning services will be discussed and a personalized technological framework for t-learning will be described and evaluated.

TV History as an Educational Medium

The use of television as a learning device has a long history since its potential as a learning tool was almost immediately recognized. The first attempts to employ television for educational purposes are reported back to 1930s, when the State University of Iowa prepared the first televised educational programmes. Less than a decade later, elementary and secondary schools used commercial TV educational programs (Leslie, 1980). As the penetration of TV at home was increasing, more learning services were provided. By 1960 more than 50 educational stations were operating in the USA, and by the beginning of the 1960s and the 1970s the development of educational TV was further accelerated by the launching of communication satellites and the growth of cable TV. However, the overall quality of the educational programs produced at that time was mediocre, since most of them focused only on presenting lectures.
Traditional television broadcasts provided only one way information transmission with no possibility to interact immediately with the instructor or a remote co-learner. In the next years, technological developments helped to overcome some of these limitations. One of the first attempts to engage viewers and to add interactivity to educational TV was “Winky Dink and You.”, which is considered to be the first interactive program. During the 1970s a number of interactive television experiments were organized, including projects targeting to education and training. In the next years many different services were developed including combination of TV and telephone line (Jack & Tsatsoulin, 2002) to deliver text and graphic data to the TV screen, as well as cable interactive services that supported quiz answering with the remote control.
During the 1980s and before the advent of personal computers, TV sets were often used as precursors for of online service terminals. At the same time telecommunication technologies and infrastructures were developing rapidly and provided more interactivity in media applications both at home and in school. These new technological devices required better interactive skills from users. Increased user literacy, in turn, paved the way for more interactive projects during the 1990s. Most of them were short-lived, mainly because the technology that was required to implement them was too costly for average consumers. Some companies attempted to simplify user technologies and offer cheaper services; while others diversified their products (Carey, 1996).

The latest technological developments promised to enhance realism of instructional programs by applying High Definition TV (HDTV), multi-channel sound, and virtual realities. To overcome some inherent limitations, television technology was often combined with telephone, fax, video recording, and later with internet and mobile technologies. Although the research and development in iDTV-based t-learning is rather limited up to date, some interesting approaches have been presented. Some basic ideas regarding t-learning were expressed in (Aarreniemi-Jokipelto & Tuominen, 2004), while in (Aarreniemi-Jokipelto, 2005) a t-learning model was proposed based on MHP, which included personalization and interaction features. An interesting approach was the technological framework for TV-supported collaborative learning, which was proposed in (Lopez-Nores, et. al 2004). In this work, t-learning contents were developed with appropriate tools and delivered, however personalization was not supported. In a more recent work (Vrba, Cvrk, & Sykora, 2006) a more general framework was presented with content creation serving general purposes. Although the aforementioned approaches were promising they still haven’t been tested thoroughly in iDTV or simulation environment.

iDTV basic technologies

From the technological point of view, digital television mostly relies on the Digital Video Broadcasting (DVB) standard, characterized as DVB-T for terrestrial, DVB-S for Satellite and DVB-C for Cable transmissions. DVB has been defined by a consortium of public and private organizations in the iDTV sector (Digital Video Broadcasting 2007).

In the DVB schema, the digital TV signal is transmitted as a stream of MPEG-2 data known as a transport stream. This stream consists of a set of sub-streams (elementary streams), where each sub-stream can contain MPEG-2 encoded audio, MPEG-2 encoded video or data encapsulated in MPEG-2 stream. Hence, the interactive applications are included as part of the MPEG 2 broadcast stream and information about the structure of such interactive applications (application signalling, which is necessary for making them run on the STB) is also broadcast.

Then, the transport stream is fed to the multiplexer and subsequently to a Radio Frequency (RF) transmitter in order to be broadcast. The overall broadcasting system for digital TV is illustrated in Figure 1. The received signal is demodulated and afterwards it is decoded appropriately. As most of the common TV sets are manufactured to deal with analogue signals, a device called Set Top Box (STB) is utilized to transform the digital signal. This devise provides also a middleware, based on an embedded Operating System (OS), which is an execution environment for running the interactive applications that are broadcast in a channel together with the main audiovisual stream. Execution environments are standard and the most common are: the European Multimedia Home Platform (MHP), the American Open Cable Application Platform (OCAP) and DTV Application Software Environment (DASE), the Japanese STD-B23/STD-B24. Since MHP is the standard in Europe and a subset of it, the Globally Executable MHP (GEM), is becoming the common reference world-wide, in this article we focus on MHP.

MHP is the middleware system for interactive TV development designed by the DVB Project (Interactive TV Web 2007). The first draft of MHP was released in August 1999 and the first version of MHP 1.0 was approved by DVB in February 2000. MHP offers a standard platform for application developers. Applications are written in Java and HTML, so they don't depend on any single hardware platform or operating system. Due to the iDTV's special context, MHP-Java applications are slightly different from normal Java applications, however due to the similarities with Java applets, MHP-Java applications are called Xlets. There are 2 main types of DVB applications. “Interactive” applications (e.g. games, interactive advertising), which are based on Java, and “declarative” applications (e.g. SuperTeleText), which are based on HTML. Actually, since MHP specifies several restrictions and integration to the standard version of such programming languages, the actual MHP versions are named DVB-J and DVB-HTML, which we sketch in the following subsections.

MHP provides support for those features which are required for digital TV as low-level access to the transport stream, service information access, and support for the specialized graphics model of the digital TV. The introduced limitations of MHP are mainly related to the constraints given by the STB's hardware and OS in terms of computational power, memory size, storage, communication facilities, screen resolution, font and colour availability and their size is severely constrained by the limited bandwidth available. MHP can be extensively exploited by t-learning as it offers the proper middleware for learning interactive applications.

IMAGE GOES HERE

Figure 1. Digital TV broadcasting system

SETTING THE STAGE

Nowadays the introduction of remote education systems in the computer world with the help of internet has undergone an important growing rate. On the contrary, the development of similar services in the TV media is in the initial phase of study and the technical capabilities of the medium to support such services have still to be deeply investigated. For that reason the design and implementation of t-learning services constitutes a major challenge as it implies the adaptation of e-learning services to TV. The critical differences that be observed between the t-learning and e-learning world are described below:

- TV users have a lower level of preparation and predisposition to learn new technologies than Internet users.
- The way to access information in TV is traditionally passive, unlike the more active role that Internet users use to play.
- The information distribution mechanism of digital TV is much more complex than the Internet model, principally by the packing of the course information and the signalling of the transport stream.
- The data formats of the Internet courses have text and graphics as a central axis, while TV should promote audio and video in a natural way. In any case, the greater level of fluidity present in the contents in this media demands a greater interrelation among contents and a temporal reference.
- The Set Top Box (STB) largely differs from a Personal Computer (PC) as it has less computing power and local storage and it supports lower resolution.

For these reasons, the architecture of a system, which could create, distribute and execute learning courses by digital TV is still an open field, with multiples uncertainties to resolve. The MHP standard could represent a suitable technology to develop an iDTV platform able to provide arrange of new services that combine video and data and give viewers greater control over what they see, in comparison with other traditional services. Moreover, iDTV permits consumers to combine the full motion TV with the interactivity and personalization offered by the Internet.

The main characteristics of iDTV can be summarized as follow (Baker, Pulles & Sasno 2004):

- *Personalization*: in iDTV refers to the use of technology and viewer information, in order to tailor interactive content to each individual viewer profile.
- *Digitisation*: refers to the technological advancements that allow better quality of sound and picture.
- *Interactivity*: the control moves away from the networks and is directly placed into the hands of the potential consumer. iDTV can be considered as the convergence of two different technologies: television and computer technology (and more specifically the Internet).

This case will deal with the creation of advanced learning services within the iDTV environment exploiting the existing technologies in a pedagogical way and adapting e-learning features accordingly. More specifically we will propose an open flexible platform for the development and presentation of personalized interactive t-learning courses. To design such a platform we first analyze t-learning from a pedagogical view and also discuss the opportunities of personalized learning.

T-learning pedagogy and methodology

Interactive Digital TV (iDTV) is considered as the convergence of television and computer technologies by encompassing three important features typical of computer-based technologies (Lytras, et al. 2002): interactivity, personalization and digitization. Subsequently we will discuss the most important strategic issues related to learning on TV. First of all, the biggest opportunity for the development of learning services is likely to be through personalised TV – as content on-demand or through “personal” delivery services.

These new interactive digital TV services have already started to emerge and change the way the viewer interacts with the TV from a passive to a more active mode. This is creating new opportunities for increasing its role in learning. Therefore, ICT policies that are aimed at encouraging increased and widening participation in learning should consider the role that interactive digital TV solutions have in creating new learning opportunities in the home. Such forms of interactive services will become integrated into hybrid developments with more personalised TV, possibly being used as “hooks” to capture interest and pull people towards more engaged learning opportunities.

The TV environment includes features that differentiate it from PCs. First of all, TV is usually watched by more than one person (co-viewing), and usually triggers social interactions that are very useful for a more effective experience and interiorization of the contents. Secondly, the logic of broadcasting to a wide population enables social mass mechanisms that typically enhance the impact of the broadcast program. In defining a t-learning pedagogy it is, thus, crucial to deal with an active learning model, the constraints imposed by the actual development of the technology and the nature of the allowed interactions. In this context the challenge is to exploit the added value of providing an interactive learning environment and the potential of allowing people to access learning activities and contents directly in their house, at distance, through media easy to access and simply to use.

This reflection produces a twofold vision that aims at balancing learning and teaching strategies:

1. Guide the learner with proper contents.
2. Leave interaction control to the learner.

Thus, to draw a pedagogy for t-learning experiences two dimensions have to be explored and taken into account as the drivers of the design process:

- the context where learning happens and the behavior of learners in this environment;
- the specific features of the medium, in particular the contents and the pace of the audiovisual (AV) stream.

The interactivity, audio/video-based experiences, narrative learning environment and informal learning/edutainment are the key points that emerged from this exploration. In order to deliver such services to the viewer, a learning oriented technological framework has to be developed to support efficiently the creation and presentation of t-learning courses.

Personalization in T-learning

In general, the actual purpose of personalized learning is to provide a learning path that is matched to the learner's needs and abilities, resulting in a more efficient and high quality learning process. In order to obtain this matching of learner’s profile and objectives, current learning context and available pedagogical resources, a well-defined description of each component involved in the process is needed, with specific focus on the user model. An additional interesting aspect of the personalization process is that, once the user model has been identified, the accuracy of the personalization can be iteratively improved with time, as more dynamic data are collected and stored regarding the ongoing interactions of the user with the system and the continuous monitoring and re-assessment of the user’s satisfaction. This also allows for a classification and “clustering” of learners (Blanco-Fernandez et al, 2004). Personalization in terms of t-Learning implies that a potential iDTV learner can easily be offered on his/her TV equipment a selection of available pedagogical contents and services according to his/her interests, skills and preferences.

CASE DESCRIPTION

The purpose of this case is to propose a technological framework, which could support an efficient development and deployment of t-learning applications. Such applications represent a novel educational iDTV format that can be applied in a variety of fields not limited to education.

In order to satisfy the pedagogical requirements implied by the aforementioned methodology, a technological framework has been designed and built in order to support an efficient development and deployment of personalized t-learning applications. Such applications represent a novel educational iDTV format, that can be applied in a variety of fields in education and not only.

The general philosophy of the approach involves:

- A linear A/V stream (the traditional TV program, on which the user has no control)
- Non-linear interactive contents (on which the user has control)

This schema is realizable through existing TVs, equipped with STBs, thus reaching a wide share of population. Although internet connection (even not broadband) is not required, additional services included in the system are capable of exploiting it, in order to enhance the user interaction and experience. On the other hand, non-linear Audio-Visual (A/V) stream contents would require (at least with present technologies) broadband connectivity, which is not supported by the majority of current TVs.

The proposed architecture, which is illustrated in Figure 2 is split in two parts: the production side where the content is prepared and the receiver side where the course is presented to the viewer through the appropriate terminal.

IMAGE GOES HERE

Figure 2. Technological Framework

The production side is the area where the course content is created. As the course development is based on the requirement of reusability, the content is structured in the appropriate format so it is playable by a Course Multimedia Player which is also transmitted with the course package.

From a pedagogical point of view, this schema involves an important role of the author, who defines the learning space and provides strong guidance by defining the A/V stream, the scheduling and the contents, and of the user, who has a certain freedom in exploring this knowledge space (e.g. deciding whether to perform an interactive test/quiz/game or not, decide which branch of the course to follow). For any course’s implementation, the author can decide the desired level of freedom/customization (e.g. by preparing contents for various categories, setting user-performance-based triggers for more information cards, quizzes, letting a number of parameters variable for personalization, etc.). The technological framework is based on the idea that the course consists of resources that can be presented at runtime by the proper course player software. Modularity, re-usability, customizability, flexibility, extensibility, homogeneity are the keywords of such an approach.

T-learning Course Structure

The course creation is based on the structure of a Learning Object (LO) (Marta Rey, et al., 2006). A Learning Object can be defined as both the basic unit of a learning experience and as a small, atomic chunk of learning that can be reused in different context. In other words, the LO structure is actually an aggregation of items, which grants a customizable and flexible reuse. Following this definition and by adopting the LO model specifically developed for t-learning courses, it is possible to integrate several multimedia components and thus create educational material and content suitable for distribution through an iDTV infrastructure. Thanks to this model the content author can manage separately the various components, as well as the parameters that define their behavior, and then generate in a simple way the final LO (course).

A t-learning course is considered to be composed of the broadcast video and the interactive application, which are running in parallel. The interactive application is divided into the static and the dynamic part. The static includes a set of highly customizable multimedia educational units, which are called cards, while the dynamic defines the flow of the course in time by the different condition-based paths, the synchronization with the A/V stream and the interactions.

In the static part, each card provides one or more services, which are author-customized instances of service templates. Such services include: multimedia pages and presentations, interactive edutainment elements and support for ancillary devices. These items can be presented at runtime by using specific MHP-java classes, which read the property files that are created at the production side. This means that several different instances of the same item can be presented with the support of the same classes that will read different property files at runtime. This is very important for the runtime environment of the STB as one of the major constraints is the limited bandwidth of the transmitted applications.

The main objects nested in the script are called cards and can contain either a multimedia page (MPage) , which may consist of texts, images, audios and buttons accompanied by the TV stream in various formats (e.g. inside a quarter frame), or an interactive edutainment unit, such as a game. As multimedia page is considered a normal page that could appear in the TV screen while games include quizzes, puzzles and so on. Multimedia page and games instances are illustrated in figures 3 and 4 respectively.

IMAGE GOES HERE

Figure 3. Instance of a Multimedia Page

IMAGE GOES HERE

Figure 4. Instances of Games

In order to support reusability, the above items (Mpage and games) are implemented as specific templates, which are fully configurable in terms of contents and appearence. These templates can thus be instantiated one or more time in a course. Configuration files also support personalization. That is, the properties of a single template instance can further be parametrized according to the dynamic (i.e. evolving even during the course) profile of the end-user. This is achieved through the introduction of parametrical tags that can be parameterized by the course content author on the parameters defined by the Personalizer's module which is described in the next section.

The dynamic part of the course, which represents the actual flow of the cards (figure 5), is encoded in an XML script which is called "course script" and it is interpretable at runtime. This script includes the following information:

- Declaration and synchronization of the cards with the underlying iDTV A/V stream (thus directly enhancing the current TV program) with time stamp definition.
- Declaration of asynchronous cards which are accessible at any time during the course. Such cards could be general information or help related multimedia pages.

- Links to the corresponding property files of each card to load the properties of a multimedia page or a game.
- Declaration of navigation bars, that consist of 4 sets of menus (one per each remote control's colored buttons) that provide the user access to additional functions (e.g. personalization services, more-in-depth info, helps, etc.). The navigation bar, which is displayed as a stripe at the bottom (or top) of the screen and is controlled through the 4 iDTV colour buttons (red, green, yellow, blue). Sample functionalities can be offered by the navigation bar include: personalization settings, choice of course categories, exit/hiding/restoring of cards, helps, further info, other advanced services. Functionalities are grouped in 4 clusters, each one of which is mapped to (and accessed through, by end-users) one the four coloured buttons. A course may have several different navigation bar configurations that change dynamically during the course itself in order to provide the most suited, context-aware support. These different configurations are to be specified by the author in the course script.
- Condition-based flow control of the course. Such conditions are based on the real-time value of dynamic (e.g. score, status etc) and/or static personalization variables (e.g. age, sex, etc), that are tracked and managed by the system.
- Categorized flow of the course. Different user categories can be defined by the author either regarding the difficulty level (e.g hard, easy) or specifying different approaches according to the user's skills and the context of the course (e.g. history profile, architecture profile, etc).

This XML script describes the adequately the t-learning course and is interpreted at runtime by the Course Multimedia Player on the STB. It is Object Oriented, which is close to human reasoning, easy to agree and specify. Moreover, Object Orientation is well supported through powerful development tools (e.g. UML). The script is event-oriented as well, which is particularly suited for the TV environment, where an application may be synchronized with the underlying A/V stream.

IMAGE GOES HERE

Figure 5. Dynamic part of the Course. 3 different user categories are represented.

Production Side

The main component involved in the production side is the authoring tool (AT). The AT is a visual development environment where the author is supported in the creation educational courses for iDTV. It consists mainly of two logical parts which are integrated in a common user interface:

- The script builder, which is the part for writing the course script (scheduling of the cards, definition of alternative course paths) that corresponds to the dynamic part of the course
- The card configurator part for the creation and the configuration of the instances of the service templates (e.g. Edutainment Templates) which are included in the static part of the course.

The architecture of the AT is illustrated in figure 6.

IMAGE GOES HERE

Figure 6. Authoring Tool architecture

The AT provides a clear graphical interface (figure 7) which supports visual composition features as drag and drop, content previews and object designing. The tool provides a user friently environment where authors can focus on the contents and the logic of their course without having to concern about the internal structure and the constraints imposed by the XML script.

The AT script builder, which is dedicated to the definition of the user categories and the scheduling of the cards, provides authors with an intuitive way for defining events lists (temporal or logical) and consequent actions, with the support of personalization as well. Timeline bar proved an easy medium for content authors to use since it is more comprehensible comparing to event triggered-based flow charts. The tool handles the definition of all the supported operations/instructions by using an XSD schema in a "secure" mode, thus avoiding the risk for the author to generate invalid XML files.

The AT card configurator (figure 7) is responsible for the configuration of the cards and provides a user friendly environment where existing templates can be configured. These templates include Multimedia pages with images, buttons and text, multimedia presentations and edutainment templates, which can be customized appropriately in terms of appearance, fonts, score computation modalities, content etc..

IMAGE GOES HERE

Figure 7. Authoring Tool Card configurator

The tool supports two modalities of configuring a newly instantiated service: full configuration, which gives the author full access to all the configurable parameters of the service, and the Style configuration, where the graphics are pre-defined and the author has to insert the contents (e.g. questions and answers, images to be manipulated, graphs, etc.). The first approach is suitable for high customizable solutions, but may be time-consuming and addresses mostly to experienced authors, while the second approach is more efficient since the author can focus more on content than appearance while authoring process becomes more rapid and homogeneity insured.

Client Side

The Course Multimedia Player (CMP) is the t-learning client software that reads the data generated by the authoring tools to present the final course. It runs on the user MHP STB to allow interactivity between the learner and the application.

Two main steps in the playing process can be identified:

- Building the interactive application.
- Executing the application with the video.

A. Building the interactive application

As explained in previous section, the course script file contains all required data to instantiate a course. By reading this xml description file, the multimedia player creates the static part of the course (each page/card) and the dynamic part where navigation, personalized path based on the user profile, and synchronization with the TV-program are involved. When a T-Learning application is launched by a TV viewer, the Course Multimedia Player parses the corresponding scripts to instantiate the T-learning course. Subsequently, the following components are involved.

- Graphical Rendering Manager
- Navigation Manager
- Synchronization Manager
- Personalization Manager
- Interactivity Manager

1) Graphical Rendering Manager

This part is responsible for the graphical interface. It displays all the course components and manages the video stream rendering. For instance, following the course creator choice or according to the Personalizer’s values, each course screen can be displayed in 3 different modes: full Screen (FS), full Screen with TV picture (FSTV) and Stripe (S).

2) Navigation Manager (personalised)

Interpreted at runtime, the course path can change following several rules from the personalization manager. This path can also be influenced by the synchronization manager or the user interaction. It allows a dynamic adaptation of the learning path.

3) Synchronisation Manager

Synchronization is realized between the TV-program and the application. Indeed, regarding the timeline, some time triggers (they may correspond to events such as beginning of the first part, end of the second part) are listened by the synchronization manager in order to take adequate actions. For instance, start an application or change the section in a course.

4) Personalisation Manager

The Personalizer keeps track of the dynamic user profile (e.g. current values of the user interaction, such as score, what pages have already been visited, what quizzes, etc.) and of the persistent user profile (e.g. preferences, age, etc.).

5) Interactivity Manager

Finally, the Course Multimedia Player manages Interactivity. Interactivity is considered in two levels:

- Local interactivity: it is provided by programmable components that enable the action of the user on visible parts of the screen and change the behavior/settings/appearence of the objects that are displayed, without the need of a return channel. The user can access local interactivity simply through her/his remote control.
- Server interactivity: same as local interactivity but the actions of the user are sent to a server as “requests” via a physical return channel and the behavior of the displayed objects is modified through the reception of “commands” from the servers, application servers or broadcast server. For instance, the server interactivity can be used to store general data in a centralized way or also to request additional information on a given topic.

Results

In order to validate the above framework and also preview the courses that are developed through the authoring tool, an iDTV simulation environment was employed. We have selected the MHP analyzer from IRT software, which is capable of running MHP applications.

During these tests it was possible either to preview the performance of the static parts of the course independently or the complete course synchronized with the video. Using the AT, the author could iteratively design and implement the cards, fix their scheduling in the timeline and check the preview. The preview functionality provides two levels: single card level and course level. The first one allows immediate inspection of any card, just after its development, while the second one allows analyzing the whole course, checking also the overall scheduling, navigation and learning paths alternatives. The integration inside the AT allowed an instant preview of the course making the testing procedure easier. This intensive testing proved itself to be useful also to signal bugs of the CMP and of the AT, and highlighted the need for improvements and additional functionalities as it emerged from the concrete experience of the course developers. These iterations were important to complete a fully functional t-learning framework comprising of a runtime multimedia player and an offline authoring tool that satisfies the requirements of the pedagogues and the content creators.

Using the authoring tool, an interactive enhancement of the "Snow White and the Seven dwarfs" animated film from Disney has been implemented, in order to support the study of English as a foreign language. This experimental course was created in order to further test and evaluate the framework also from a more technical perspective, considering most of the supported functionalities and realizing multiple course paths with complex sequences and conditions. In addition several experimental t-learning courses were created by pedagogical experts in different knowledge domains and served as an important test and evaluation bench for the framework. (Bellotti, Vrochidis, et al. 2008)

IMAGE GOES HERE

Figure 8. Couples Game preview

Figures 8 illustrates a Couples game from this application. Functional tests have been successfully run in real context of use settings, where the course run on commercial STB and is displayed on TV set and users can interact through a remote control.

CHALLENGES

The main challenges we faced during the implementation of the aforementioned framework had to do with the enhancement and possible integration of various technological advancements, in order to promote more advanced t-learning practices and enhance the interaction in an online t-learning application, as well as with the adaptation of the knowledge and the technology from e-learning to t-learning world.

More specifically, we had to deal with t-learning courses that included different formats of information (video, audio, text, images, graphics, software applications to provide animations and interaction, etc.). Furthermore, each piece of information was interacting with the others, depending on the events it can produce, its invocation capabilities and the capability to refer to other components in the system. This involves the evaluation of adequacy to the iDTV characteristics of new information formats as MPEG-4 or MPEG-7 (MPEG, 2002), not quite used in e-learning yet. When using an MHP-based platform, the downloaded applications (DVB-J applications) must obey a set of restrictions related to the execution environment and to the capabilities of the STB.

For that reason the design and the implementation of such tools that would deal with content declaration, automatic checking of restrictions existing in the model, automatic generation of software applications following the MHP standard, integration and information packing, generation of the configuration files for signaling the course information and management of the courses was considered a very complicated task.

The receiver side was also complicated as the set of information defined in the production side had to be received in the Set Top Box through an object carrousel, as defined in the DVB-MHP standard. This information had to be rendered and visualized by a software application in charge of the coordination of course execution. In the Set Top Box could be performed by a DVB-J application, periodically transmitted through the same data channel of the iDTV service used to broadcast the course. Such application should be able to accesses all the course structure in order to obtain the proper information to locate within the transport stream all the objects belonging to a specific course and to coordinate their execution and representation, as well as the user interaction.

SOLUTIONS AND RECOMMENDATIONS

The proposed case contributes by suggesting an integrated personalized learning environment for the development, delivery and presentation of educational material. The main challenge involved is to exploit and enhance the technologies from digital TV and computer domain so that they are useful for education. The presented approach to iDTV is evolutionary, rather than revolutionary. That is, it still considers the TV program as a linear audiovisual stream that may be enhanced through simple interactivity. This is due to the still high popularity and pervasiveness of the TV as medium for supplying relaxed/informal information and stories. During the course creation, a clear structure for the content is defined, while the template logic allows reusability, which is a big advantage at the iDTV world where the available bandwidth and the storage capabilities of the STBs are limited and the production costs are high and the time-to-market short. Moreover, the configurability option allows the insertion of personalization, which is considered as an added pedagogical value. This template-based approach allows the creation of flexible, standard courses that are interpreted by a multimedia course player running on a STB., The player interprets the course configuration script and accordingly presents the structure content to the viewer and manages her/his interaction through the remote control. Another advantage of the proposed framework is the extensibility as it is possible to support services on demand, also by exploiting the return channel of the STB, and including other kinds of contents, such as virtual avatars and more complex games. On the other hand, the most important constraints to the adoption of t-learning have to do with the comparison done with the existing e-learning services. First of all, the barriers to entry into the interactive digital TV market are high for the learning business compared to e-learning. In addition, the policies regarding the use of information and communication technologies for increasing learning opportunities are already being directed towards to the use of a computer connected to the Internet. Finally the existing players, who are already established in the “learning business”, are very reluctant to enter this market due to the potential high costs of developing for multiple platforms and the uncertainly of getting any return on investments.

FURTHER READING

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KEY TERMS & DEFINITIONS

authoring tool: environment for applications creation without the need of programming and technical skills.
e-learning: distance learning with the aid of Personal Computer.
framework: a basic conceptual structure of interconnected modules that is used to address complex issues.
iDTV: interactive Digital TV is the evolution of the traditional TV set based on digital.

transmission and has the capability of running interactive applications.
MHP: Multimedia Home Platform is the common middleware for running applications for iDTV.
Personalization: the customization and categorization procedure of a viewer-learner.
STB: Set Top Box is the device that decodes and processes the digital received signal.
synchronization: this term is used to specify the time-matching between the t-learning content and the respective video so that the t-learning course could be presented in the proper way to the viewer-learner.
t-Learning: term that defines the TV based interactive learning.
t-Learning course: a set of educational modules that comprises a course for iDTV.