Development of interactive television t-learning course

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***Abstract*-- Paper presents some of the latest advances in the use of iDTV for educational purposes offering learner to actively participate in the course. We explore the potentials to expand the power of iDTV by delivering interactive learning into the home and present open issues and development experience respectively. Paper presents research results of IST project ELU – Enhanced Learning Unilimited.**

***Index Terms*—Distance learning, DVB, DVB_T, e-learning, MHP, Interactive Digital Television (iDTV), t-learning.**

I. INTRODUCTION

We would probably agree that television (TV) plays a major role in the society. TV is a familiar and reliable consumer device with 95-99% penetration in European households. It has an impact on nearly anyone from informing, entertaining and educating point of views. Through out the TV history television viewing was usually connected with entertainment. Therefore, traditionally TV is perceived as a medium for relaxation medium.

Interactive media users hunt for challenges as is the case for example in computer games, but can also be present in interactive television [1]. We expect that iDTV technologies will open a new era to e-learning using the mass-market broadband TV (Figure 2).

Household penetration of digital TV is high in some EU countries and growing in others, analogue switch-off is scheduled for period from 2007 to 2015 in EU member states.

Paper presents some of the latest advances in the use of iDTV for educational purposes offering learner to actively participate in the show. We explore the potentials to expand the power of iDTV by delivering interactive learning into the home.
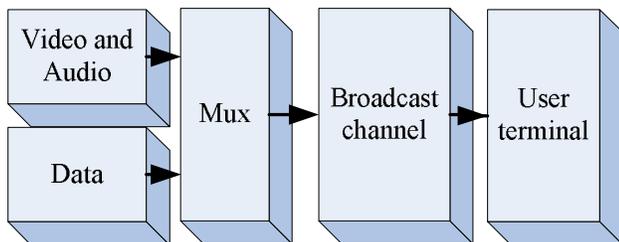

Figure 1: DVB allows inclusion of data in to a broadcast stream. This allows inclusion of content not directly connected to audio/video stream.

II. FRAMEWORK

Goal of the study is to investigate the possibilities to bring learning opportunities to households equipped with television and low-priced Set-Top-Boxes (STB). We are trying to reach whole EU population, especially those without computer or / and internet connection.

The whole chain of creating a learning course for Digital television is being observed and evaluated.

Europe has adopted DVB-T (digital video broadcasting – terrestrial) for broadcasting the digital television signal. The DVB- T standard may be considered as a substitute to free air analogue broadcast. DVB-T standard was picked by the ELU due to its availability in every household.

A. Digital Television

The introduction of DVB DTV services has opened up many new vistas. DTV brings more TV channels, better quality in picture and sound. Furthermore DTV has the ability to include data in a DTV broadcast stream along with the audio and video. This capability can be used to provide an enhanced experience for television viewers (interactive television data broadcasting), and it can be used to deliver data for applications that have no direct connection to television programming (general purpose data broadcasting), such as Electronic program guide (EPG)(Figure 1).
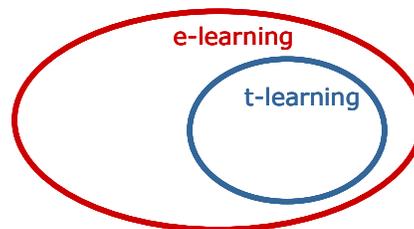

Figure 2: t-learning in the framework of e-learning

The interaction channels, part of DVB standards, between the viewer and the network operator or content provider enable full interactive services yet to be explored (Figure 3).

III. T-LEARNING OWERVIEW

T-learning context has specific features:
- the possibility to use high quality video;
- limited interactivity caused by the remote control as
- the only end-user tool;
- limited interactivity for users with low-end STB;
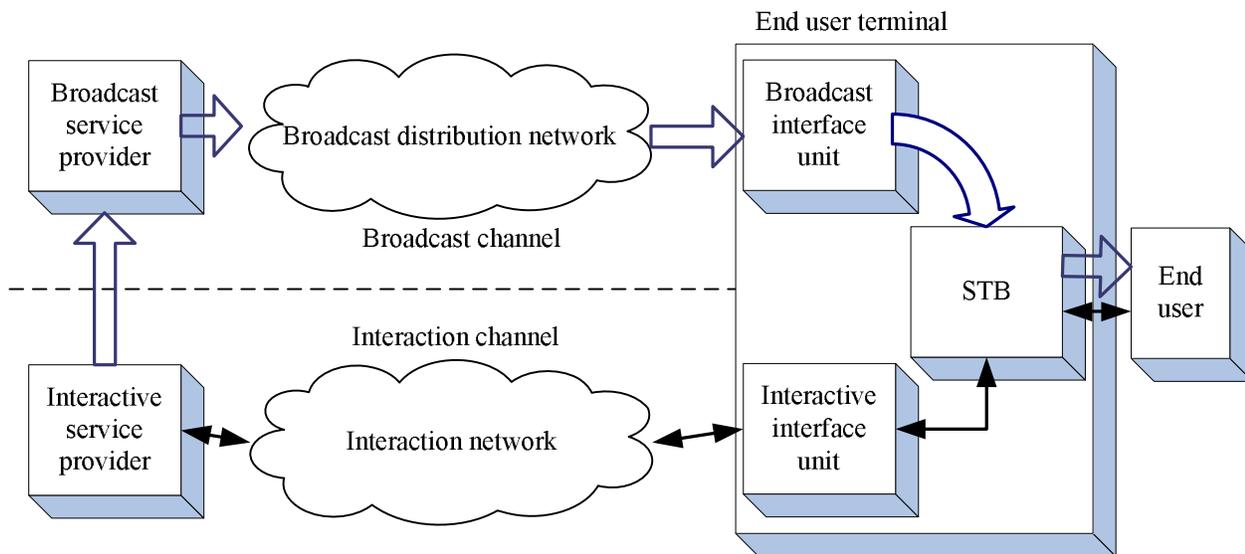- limited possibilities for personalization.

Figure 3: DVB standard allows implementation of return channel through which additional content is accessible or user feedback is collected. It allows interaction between the end user and the interactive service provider or user can interact only with the content held on a STB.

The video stream is the core of the television program. It is a traditional TV learning element that has been used for many years, including in analog TV. It offers the possibility to present learner with the content in realistic and visually illustrative way.

Remote control is a simple device and offers only limited possibilities for interaction. All the content prepared is navigable with simple instructions that can be done through remote control.

High personalization of content is possible through the use of return channel. It allows content creators to conceive course in a way to support those who want to learn more or to get more specific content.

Return channel is in practice not available with the DVB-T standard. Return channel has to be implemented through the IP supporting channel supporting technology as for instance PSTN, Ethernet or xDSL. Furthermore technology has to be supported by a STB.

Market offers a variety of STBs with support either to standard definition or High Definition TV (HD). The choice of specific type of STB and its performances depends on the network operator and its decision which features and services wants to offer to the end user.

Elementary set top boxes enable only limited interactivity. Furthermore these STBs offer limited resources in terms of memory, interface and processing power.

When talking about interactive digital television, the low end STBs have to be considered. Majority of population want to keep their TV system as cheap as possible.

A. Potentials for t-learning

Interactive TV offers potentials for increasing learning opportunities at home, school and work. A direct impact on the pedagogical approach may be related to the availability of a return channel.

Traditional television broadcasts provide only one way information transmission. In addition, learner has to schedule his learning activities according to program schema. As a result, analog broadcasted TV is found to be insufficient medium for more engaged learning [2].

Currently two types of services which enable on-demand learning activities are available:
- Video or Content-on-demand services from remote servers.
- Home storage using personal digital video recorders.

Both methods have similar functions to that of a videocassette recorder - stop, start, pause, rewind and fast forward. It is even possible to stop a live broadcast and start it again at the point the viewer has left off.

B. Interactivity

Today interaction in terms of television refers to the use of remote control to request information over and above the show that is being broadcasted. End user is able to control and influence the subject of communication [3].

Interactivity is divided according to the part of DTV system that is used, namely local interactivity and global interactivity [3]. Local interactivity defines interactivity between user and the content held on the STB via the remote control. Modern DTV systems are able to provide additional interaction between the end user and the broadcaster or service provider, defined as the global interactivity (Figure 3).

To learner interactivity means that the he is allowed to actively influence the behaviour of broadcasted television, services, and applications. The technical prerequisites for the interactivity in the iDTV based learning environment are a return channel and a broadcast channel. A return channel enables leaner responses and additional functionality.

In t-learning local interactivity is an excellent mode to support gaming / edutainment learning process as well as provide generic complementary information. It is an effective mean to further consolidate the learning experience and better understanding of a course.

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Return channel	iDTV	t-learning
No Return channel	- weak interactivity	- student-learning material
Return channel	- hybrid interactivity - collaborative interactivity - strong interactivity	- Student-learning environment - Student – student(s) - Student(s) – teacher

Global interactivity is well suited to provide the viewers / learners with highly personalized content, enabling content creators to conceive course in a way to support those who want to learn more or to get more specific content, adapted to each context / situation. It is an excellent mean to allow viewers to specialize in what they want to learn and interact with other learners or teacher. Furthermore, it is a prime mean to enable learners to tab in to much wider external knowledge sources in order to find answers to questions the local content is unable to cover. It is a window opened to shared knowledge.

To reach all potential end-users ELU consortium has made a decision to use mainly broadcast content with limited interactivity possibilities. The idea is to make content accessible independently to technical capabilities of end user terminals [2].

IV. T-LEARNING COURSE DEVELOPMENT

A. Video Stream

The TV video stream is an excellent mean to convey the core educational concepts and information of a course (it is a powerful communication tool and allows powerful graphical illustrations). In addition, the video stream is considered by the TV viewers as the central content element.

In a t-Learning context video broadcast represents multimedia rich content that can educate viewers on a given theme. It is a traditional TV learning element that has been used for many years, including in analog TV.

Streamed video should be produced as a central element in a t-Learning course, where the viewer / learner is familiarized with the core concepts and shown realistic visual illustrations of a course.

The video broadcast is the kernel of a t-learning course providing the learner with fundamentals. As a complementary educational content that can be used to enable further specification and an individual exploration of additional subjects VoD can be used.

In the DVB-T environment the band for delivering content is one directional. Therefore it does not allow transmission of large packets for individual users.

The adaptation of content according to user's needs and preferences is therefore in practice not possible through video.

B. Interactive Elements

To present the user with complementary content for individual exploration we use interactive applications. We have defined two generic types of learning elements:
- Multimedia pages and
- Games.

A course may be considered as a set of educational units named cards. These cards are author-customized instances of service templates. Furthermore they can be synchronized with the A/V stream or can be asynchronous.

1) Multimedia Page

Multimedia page has a presentational functionality. In addition to text the content creator has a possibility to build it from variety of multimedia elements: Figures, video, audio.

Multimedia page framework allows flexibility. Multimedia elements used in the multimedia page can be placed and scaled according to content creator.

The only restrictive factor in terms of content is the size of the multimedia elements used. STB resources are limited. Furthermore, the data has to be transported to the learner's STB.

Navigation in the Multimedia pages is generic and allows only the use of arrow buttons and "OK" button. With this restriction content creator is forced to keep the navigation simple. Furthermore the use of navigation buttons is by default consistent.

2) Games

Games are considered as a very promising paradigm for developing skills and promoting knowledge among a wide audience. It sustains active participation in a meaningful context that stimulates the use of knowledge coming from different areas in order to achieve the goals. It stimulates reflection through problem solving practices where an active player constructs the strategies to find her solution and carry on the adventure. In this way, the game allows to experiment the backlash of decisions and actions. It can support social interactions like playing for cooperative purposes as well to challenge other players, and improve, in this way, social skills. The game-based approach stresses the motivation of the learner.

Games are used to ask user questions. This can either lead to encouraging the user to get actively involved in the course or for testing knowledge.

Implemented games are simple to navigate. Though, the content creator has the possibility to adopt the navigation according to the content. Use of all except coloured buttons is possible.

Games through their score offer simple way of personalizing content. User's content for instance can be displayed according to their achieved score.

C. Virtual Teacher

Virtual teacher (VT) can be implemented as an overlay in the audio video stream or in games and multimedia pages.

VT is "an instructor, who, through electronic means, provides courseware and instructions, responds to learners' questions, and provides feedbacks and course assessments" [2]. In PC-based learning this role is often played by a tutor (human person) who uses tools like e-mail, chat, forum, telephone to support the learner(s) in his learning process. [17]

In DVB-T learning environment there is no practical way for personal assistance. The VT in ELU is an avatar who guides the learner through his learning path in a similar fashion as a tutor in PC based learning. VT is guided by an expert system allowing him to behave in an autonomous fashion and yet be able to interact with the learner in a sensible and productive way.

The VT behavior is programmed by the content creator to support the specific content as for instance:

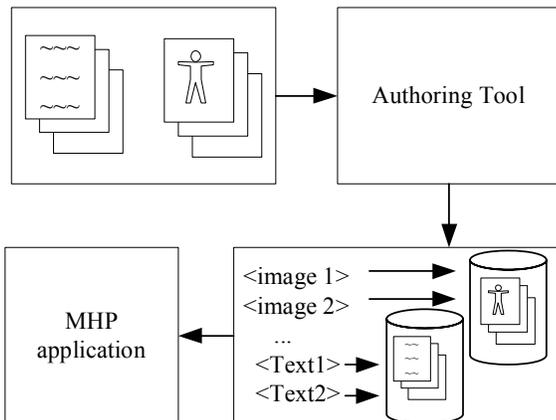- ask specific questions
- provide the required reaction.

Figure 4: Presents the use of Authoring tool in process of creating MHP applications for learning.

D. Authoring Tool

In addition to creating custom courses the technological framework to allow modularity, reusability, customizability and flexibility has been built. All stated interactive elements presented in IV.B and IV.C can be integrated through the Authoring tool, which was built by the ELU consortium. [16].

Each card may be considered as a container that can be filled with various kinds of services and multimedia elements. Cards are fully configurable in terms of content and appearance.

To keep the interactive part of the course as small in size as possible card templates can be instantiated one or more times in a course. Each time the card is used it uses instance specific
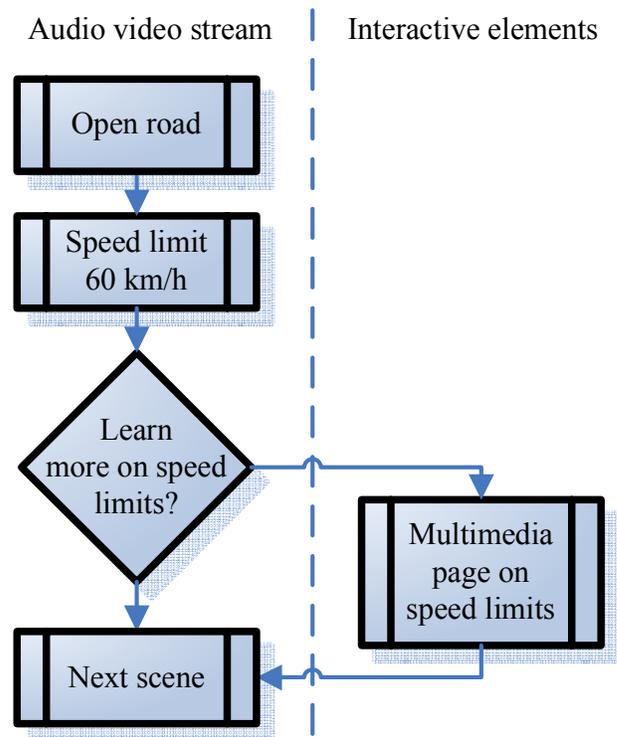

Figure 5: Simple scenario of possible paths through the score. Learner is at the time of the event offered to navigate the course to the complementary content.

configuration file defining the card's specific content and appearance.

Configuration of cards takes in to account different users. This allows content creator to personalize cards for various groups of learners.

Personalization of content happens on two levels:

- Personalization of content: According to user profile and user's preferences adopted content is presented to learners
- Personalization of scheduling of the cards: According to user's progress and profile the content can be scheduled to appear at different times in the course.

Personalization is due to assumption that there is no return or narrowband return channel kept simple. Content creators treat can scheduling and content for different users present in a tree like structure.

All the interactive elements are MHP applications which are configurable through the XML file. The Authoring tool builds the XML configuration files and arranges the interactive applications and Multimedia content in to folder structure (Figure 4).

V. COURSE ON DEVELOPMENT OF TRAFFIC SKILLS

Broadcasted audio video stream enriched by the interactive elements are setting the ground for six courses developed in the ELU project [2]. Each course is aiming at different target group that vary in age and interests.

Development of traffic skills course will have supplementary role. t-learning course will be used to provide additional, extra learning services and materials. The use of t-learning is not mandatory for a learner, because other media and face-to-face learning are the primary forms.

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Focus group of this course are people that fulfil the criteria for driving license. This is adult population. We divide them in two groups:

- those who already have their driving license and
- candidates for it.

The first group consist mostly of drivers that have their driving license for some time, for ten or more years. Their interest in driving test is in renewing their knowledge and to get familiar with possible new rules.

The second group could also be referred to as ' the candidates for driving license' are people that intend to pass driving license test in the near future and are possibly already involved in the process of training.

TABLE 2: IMPLEMENTATION OF FIVE LEARNING STEPS THAT NEED TO BE PRESENT IN LEARNING EVENTS.

Teaching step	A/v stream	Games	Multimedia page
explanation	x		x
demonstration	x		x
practice		x	
feedback		x	x
assessment		x	

A. Assumptions

The two defined groups demand variety in the content. Video as a central element of the course is the same for both groups. Due to narrowband return channel presumption, the only possibility to bring complementary information to the user in real time is the use of local interactivity or in other words we use interactive elements as presented in section (IV. B.).

Throughout the course we were consistent to the following assumptions [2]:

- All interactive elements are connected to actions presented in Audio/Video stream.
- Additional content presented on the multimedia pages and presentations is not time limited.
- Amount of prepared content allows learner to go through the course at least three times to access all of the additional content

B. Pedagogical approaches

ELU pedagogical approach defines interactivity, motivation and the need to convert passive spectators into active learners as the main determinants of successful learning.

Three pedagogical approaches have been selected as the foundation for the ELU t-learning:

- Gagne's [2] nine events of instruction (to be used for adult users),
- constructivism (to be used for school aged children) [2],
- game based t-learning (to be used for children courses) [2].

Development of traffic skills course is aiming at adult population. Therefore we follow the Gagne's methodology.

To address specific skill and knowledge the instructional templates were built. Each of them presents a learning event and includes the sequence of five teaching steps [2]:

- Explanation
- Demonstration
- Practice
- Feedback
- Assessment

C. Selected Pedagogical approaches

The video broadcast is the kernel of our course. It provides the learner with fundamentals. It is used for explanation and demonstration of content.

Interactive elements present complementary educational content that can be used to enable further specification and an individual exploration of additional subjects.

Table 2 summarizes the use of interactive elements for reaching pedagogical objectives:

- Games are used for practice and assessment;
- Multimedia pages are used for explanations and demonstration;
- Feedback is composed of game and presentation.

D. Expected results

The biggest issue in developing the course is timeline of the broadcasted program. Learner is, in accordance with his interests and storyline in the video, offered additional content. In case he decides to follow the additional content, he will skip the main video stream. The fact of real-time broadcasting of the DVB-T content is an open issue for the pedagogical approaches appropriate for the t-learning environment.

Figure 5 presents a simple scenario of possible paths through the course. The issue is how to keep the user who decided to browse the multimedia page in line with the content presented in the video stream.

Tests will show how the users will react in situations where they will miss large portions of the core video based course.

The approach investigated is to introduce a rescaled video to follow the main story while investigating the interactive materials.

Assessment takes part after the video stream finishes. This allows the content creator to prepare part of the course that is not time limited.

VI. CONCLUSION

Digital television is a reality. First EU countries have already switched to digital transmission, soon the rest will follow.

It is undeniable fact that with digitalization of television brings much more than better image and sound quality. At the moment projects are exploring options such as t-government, t-shopping, t-gambling, etc. Only time will show what are the user expectations.

Variety of currently available applications has different technical demands. They may demand global interaction. As long as return channel, especially broadband return channel, is not available in majority of households, developers must respect these limitations and work on applications that relay mainly on broadcast content.

In t-learning, broadcast video is seen as the primary medium, being enhanced by different educational applications.

In DTV interactivity will not be the flavour of interactivity known from the computer with complex applications that require concentration, long attention spans, etc. Instead, they point out that made-for-television applications will have to live up to a new mode of interactivity particularly designed for television.

The near future will with development of broadband network bring Video on Demand service in to majority of households. VoD will allow learners to schedule the program at their own time. Content creators involved in t-learning will be able to offer learners video rich multimedia content on demand and will be able to create highly personalized courses. Furthermore the role of virtual teacher will change from avatar in to a tutor (human person) who uses tools like e-mail, chat, forum, telephone to support the learner in his learning process.

Development of broadband network will certainly make a new paradigm shift in t-learning. The lessons learned at this time will be a great value.

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