# IMEDIATV: OPEN AND INTERACTIVE ACCESS FOR LIVE PERFORMANCES AND INSTALLATION ART

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**Abstract**. Internet-based interactive TV is an emerging field affected by advances in various research areas introducing communication, network-efficiency, content management, usability, aesthetic and copyright issues. Content types that pose special presentation and interaction requirements include interactive installation art, games and multimedia productions that require synchronised content communication. These are clearly aided by the development of custom-built interactive broadcasting infrastructures offering alternative methods of content deployment, presentation and interfacing. On the experimental forefront, educational institutions are exploring the capabilities of high-bandwidth networks and experimental interactive content, setting the standards for the development of new digital services. The reduction of development, production and broadcasting costs enables single users and specialist groups interested to publish their work and appeal to wider audiences, to do so by offering a high-quality media experience in global scale. On the other hand, despite constant reduction of broadcasting infrastructure and communication costs, this new medium has yet to claim its market position and recognition. The large market-share of existing non-interactive technologies may be identified as the principal factor for non-adoption of new broadcasting technologies, followed by various quality-of-service issues and the absence of a widely accepted standard for interactive broadcasting that does not permit the development of devices supporting interaction in an out-of-the-box user-experience.
In this work we are mainly concerned with the development of an interactive TV service destined to broadcast offline and online artistic new media content. Under interactive-TV use-scenarios it may be used to support interactive exploration of interactive works and installation art over the Internet, clearly expanding proprietary interactive presentation capabilities offered today. Most importantly, under live event broadcasting, the proposed technological implementation may either be configured to enable bidirectional communication between the "active" presenter/performer and the "passive" audience, permitting new levels of interaction to be supported. This enables presenters/performers to improvise and interact with the audience, a fact that often introduces the need for transformative use of copyright-protected material. This problem is addressed via the proposal of a direct licensing scheme designed to offer the flexibility required for interactive multimedia content.

**Keywords**: Interactive TV, End-User Development and Adaptation, User Experience based Approaches, Multi-User Interaction / Cooperation, Copyright Issues

## 1  Introduction

When the first television sets was introduced to the public, it was advertised as a "Radio with a Screen", implying that the listener would be able to simultaneously listen and view the musicians performing. Clearly this was an understatement as the advanced capabilities offered mainly by the optical stimulus, were overlooked at that time. Since then, television has been employed for many "novel" purposes, including

the transmission of audio and visual content in the fields of recreation and education. Similarly today, interactive Internet broadcasting is often reduced to WebTV, as users are able to receive the same basic functionality over the web, ignoring all the new social, educational and experimental aspects that interactivity and virtual communication technologies have to offer (Tay and Turner 2009).

Various technological factors, marketing forces and content availability affect the deployment of these technologies. Established terrestrial and satellite broadcasting networks armed with strategic agreements with content providers traditionally attract the majority of viewers. In the technological forefront, one may contrast and analyse the battle in the 70's between BETAMAX and VHS technologies in which the lower specification VHS standard was selected as it offered copying capabilities. Recent examples may also be referenced, one being the adoption of BLUE-RAY-DVD over HD-DVD where the availability of content won the battle of the formats. Therefore, content availability may be identified as a principal factor that dictates which technological system will dominate the market.

During the last decade, users experienced rapid changes in the standards and formats of interactive broadcasting, a fact that may be responsible for the so called "non-use non-adoption" phenomenon, that also affects the deployment of interactive internet-based TV (Webster 2004). Initial research on autonomous interactive applications (Abascal and Civit 2001; Helena and Jorge 2001; Stephanidis and Akoumianakis 2001) was followed by the development of hybrid systems that multiplex various existing standards and formats in order to successfully accomplish the task in hand across multiple software/hardware platforms and network configurations (Webster 2004; Martin 2005; Deliyannis 2010).

When the previously mentioned market trends are contrasted to the state of affairs today, where vast content is shared by users over freely accessible video posting and live event broadcasting websites such as YouTubeTV, one may safely assume that the TV of the future will not be a passive receiver and it will most certainly involve a computerised application, enabling dynamic content selection from WebTV and other Internet broadcasting services. In fact, interactive television technologies that include dynamic video selection, computer-based content retrieval, advanced interaction technologies such as passive or interactive movies and games (Silktricky 2010) have already been employed in various Information Society fields (Deliyannis, Antoniou et al. 2009; Deliyannis and Pandis 2009), furnishing or supporting entertainment, educational, commercial and research application domains (Jaimes and Sebe 2007).

Cost is another important issue that needs to be addressed. Typically, users are not willing to be charged for services that are already available from other providers either for free or at a minimal cost. The same condition applies when they are asked to replace their equipment with new devices in order to access new services. Characteristic is the case of the transition from analogue TV broadcasting to digital in Greece that involved a public campaign informing the viewers that they could utilise their existing viewing equipment, provided they purchase a digital decoder. Interactive broadcasting systems are affected, as charges on the use of propriety coders and decoders forces many to use open implementations that are freely distributable, or develop their own. As a result, Internet-based interactive TV developers are forced to deploy open systems that support free player technologies in an attempt to attract a large user-base. In that respect, their supporting income is sourced from advertising and other means of promotion, which again is proportional to their user base.

On the positive side, decreasing Internet connection costs and increasing data transfer speeds allow the development of new interactive internet-based broadcasting services. With a dedicated internet-connection, one may receive at home high-quality TV programs, at a fraction of the cost of satellite TV. The authors believe that this is a quite significant development that allows new services to be introduced without the impracticality of replacing existing viewing equipment. Understanding user needs and broadcasting requirements is critical for successful adoption of the end-system by the users.

This article presents and discusses the experience gained in the development of an experimental low-cost interactive broadcasting station designed to present specialised content in the field of interactive arts. Interactivity in that respect presents the end-user with several options that may either result into better content perception and understanding, or enable users to influence the presenter/performer and as a result the broadcasted content. The system presented in this work is designed to cover the needs for broadcasting quality, functionality, content accessibility, interaction and user-feedback, while on the more experimental side, the overall aesthetics are addressed (Lovejoy 2004) as the art-based content requires particular presentation techniques to be employed. We conclude by discussing copyright issues that arise when content is spontaneously chosen and broadcasted live. Our work proposes the development of a licensing database enabling direct licensing of copyrighted content for direct utilisation in interactive broadcasting applications and performances, enhancing artistic expression and creativity.

## 2   User Requirements and Interaction Design

The main purpose of our developing Internet-based interactive broadcasting station is to promote artistic student work designed and produced by students and faculty staff in the department of Audio and Visual Arts, Ionian University, Corfu, Greece. Under this scenario the station fulfils a principal strategic target of the institution as it permits student-artists to expose their work through a globally accessible medium without cost constraints. Content in the area of New Media Arts introduces complex presentation requirements, as it is media-rich and non-linear in certain instances. Therefore when exposed to the public through interactive broadcasting features that include dynamic camera selection, voiceover and dynamic user feedback during live events offered through an open and expandable open source platform, it allows artists to comprehensively present their artwork in a dynamic manner (Deliyannis, Antoniou et al. 2009). The same infrastructure is used for the online and offline presentation of a wide variety of events organised by the department such as talks, seminars, conferences, concerts, festivals and field trip recordings. System requirements are bound by various interaction design issues that are discussed below, describing how developers with network and cost constraints may utilise external services in order to cover particular user requirements while minimising the network and cost effects.

### 2.1   From User Interaction Requirements to System Specification Design

Content authors expressed certain presentation and interaction needs that had to be met by the broadcasting end-system. Video, audio and mixed-media artists requested that video and audio information should be presented as accurately as possible, with minimal loss in quality, in order to match the intended presentation requirements of

the original content. This indicated to the development team that colour output and compression loss across a wide variety of signal coders/decoders should be evaluated and an adaptive presentation system should be introduced enabling the artist to set the broadcasting quality per clip. Initial analysis indicated that most of the submitted works are created or recorded in DV and DV-wide formats. Thus although support for high definition (HD) information was not critical at this stage, the system should be able to support this standard, simply by altering the encoder at software level. Under the current system this functionality is implemented dynamically as the intended broadcasting specification for each content item is stored in the content database within the stream metadata, enabling interested users to call on and view these streams on demand at their intended highest quality.

Interaction requirements were examined for various content types. First, the ability to access directly and choose the order of archived content playback is covered throughout with direct and dynamic linking to the archive. Metadata information may be added in two stages: the first set is added when the stream is uploaded to the server and includes entries that describe the streams' date, version, encoding and content format, total playing time, preview icon, stream-type and artist-information. At later stages, keywords and links may be added dynamically. The above metadata organisation enables the development of meta-searches according to user or program needs.

Three broadcasting modes are supported by the end-system: live events, video on demand and play-list broadcast of pre-recorded content. The same encoding method is employed for all three modes while multicast broadcasting with a relay server is utilised in order to overcome bandwidth problems. Although the system employs the RTSP broadcasting protocol enabling direct access from most networked devices via utilisation of the appropriate decoder, a web portal is provided in order to support the pre-recorded content broadcasting (http://www.imediatv.eu/), accessed via the videolan player, an open source playback platform available under major operating systems. This organisation follows widely accepted standards enabling thus the reduction of the multimedia stream archiving cost that is a common problem for most low-budget broadcasting services. In order to reduce streaming and storage costs, support for external streaming storage and broadcasting is provided, through the utilisation of services such as "You Tube" and "You Tube TV".

When comparing the proposed implementation with existing proprietary-broadcasting systems one may notice various advantages. The first includes the availability of direct interaction with non-edited studio-sourced content, offering for example interactive camera selection to the user. This particular feature enables direct backstage access to the viewer, a feature that has already been used to broadcast interactive multi-camera installation art content permitting remote and non-edited exploration of the scene. Various events recorded with multiple cameras may be accessed independently, offering for example remote and interactive viewpoint selection. This may include stereoscopic broadcasts where left and right-eye information is transferred through separate channels. An additional feature is the availability of bidirectional live event broadcasting, enabling direct communication between the user to the studio performers or guests. This furnishes the broadcasting station with a plethora of live communication sources that may be employed beyond the typical viewer-presenter scenarios, for example in the field of arts under telepresence scenarios, enabling remote user-artwork interaction. All interactivity options presented to the user are supported through the service's web-portal. RSS feeds and comment text forms provide user commenting and live dialogue, after

registration and user verification, enabling text information to be communicated directly to the program producers and the participating members during live events. User feedback is also supported in video format, provided they are able to visually record and publish their response into the appropriate web-service linked to the stream. From the software-engineering perspective the spiral model was employed during system development. This allows the system to evolve and grow based on user and developer feedback, while it enables the addition of new functionality at later stages, as it is based on open source software.

## 2.2 Development Through Open-source Code

The above requirements do not pose significant developmental difficulties, as they utilise existing web technologies that require little or no programming and may be deployed in a wide variety of platforms (Spinellis and Szyperski 2004). Propriety or open-source code is provided for all the above uses, from the development of a complete "station portal" to the broadcasting method itself. The web interface is an essential aspect of the Internet based broadcasting system. The use of Content Management Systems (CMS) technologies such as "Joomla!" and "Drupal" allow the deployment of a fully customisable interface complete with RSS feeds, provide for the submission, editing and publication of online articles and supporting video-works stories, discussion areas with registered users and moderators, audiovisual galleries, as well as the existence of various administrative roles with variable access privileges and the ability to develop customised templates. The proposed system utilises a database-driven Joomla! installation, while the video database is held under PHPmotion, a free media-sharing CMS.

**Table 1.** Station *requirements*, *standards* and *platforms* supporting these technologies

| Requirement | Protocol / Standard | Platform |
|---|---|---|
| Website | html, css, php, ajax | |
| Archived Video Stream | unicast, multicast, H264 | Windows, OSX, Linux |
| Live Video Streams | Multicast H264 | |
| Interactive Video Streams | multiple multicast servers, html, player | |
| Interactive User Feedback | html, rss | |
| Video User Feedback | H264, external service, html linking | |

Most of the programming effort had to be focused on the design of the user interface with particular reference to its usability and aesthetics, as the open source technologies employed do not always share the same interface standards, a fact that requires end-system web-template modification. Developers have therefore to alter the look and feel of each individual component, resulting in a unified interactive environment, which covers the functional needs of both the user and the program producer. For the current case study in particular, the summarised technologies and platform choices can be seen in Table 1, where the developmental flexibility is clearly evident.

# 3 Content, Context and User Interface

Typical television stations base their functionality on time-based programming. The viewer is informed in advance by a timetable separated in program zones for each day about the order that each video stream will be displayed. For example the daily news broadcast always begins and ends at specific times, usually presenting sports and weather reports towards the end. This is clearly an inefficient setting for Internet and satellite TV users, as they have to adjust their viewing experience according to international time. With interactive broadcasting the time-limitations are no longer present. The user is allowed to search and select the content to be viewed in live mode, or use a PVR-like function. Furthermore, as the individual components of the live broadcast may be produced in parallel, it should therefore be possible for a user who is only interested in the weather, to view the latest report on demand, or even watch the weather prediction for a specific area of the country. This major ability is mainly responsible for the differentiation between digital or WebTV to dynamic interactive TV, and the key requirement is hence to provide additional information regarding the information contained within the stream and its timing (Caschera, Ferri et al. 2007).

## 3.1 Content Retrieval

In this section a number of issues pertaining to multimedia content retrieval in an interactive internet-based TV station are discussed. It should be noted that some these issues still remain open and thus call for further research.

**Importance and Requirements.** Identifying digital content desired from a pool of alternatives is an open research area as well as one of the cornerstones of the digital era. A number of difficulties make this research direction combining Information Retrieval and Data Mining challenging, such as the plethora of alternatives to consider, the timing requirements, the transient character of streaming volumes of alternatives as well as the interaction of users in the role of creators or contributors to the metadata of the data to be retrieved.
In the context of an interactive internet-based TV station, content retrieval is of great significance in order to assist user content selection, the importance of which was aforementioned, and avoid non-use and non-adoption. Nevertheless, such a process is not trivial, as a number of requirements need to be addressed: The intermingled persistent and transient character of content broadcasted, the augmented role of users/listeners in the Web 2.0 era and the need for integration of metadata, content-based and context retrieval for audio-visual data
Interactive internet-based TV stations offer content that may be pre-recorded or can be a live event. To begin with, content retrieval in persistent databases (pre-recorded events) is not an easy process. Similarity definition can be based on any or all of (a) static textual metadata of the content, (b) content extracted features as well as (c) contextual information provided by users. To complicate things more, streaming/transient data (live events) impose challenging requirements as memory limitations do not allow for buffering, data accumulation "on-the-fly" makes pre & post processing not a possibility and high response time is a necessity.

**Persistent Data.** Persistent data information retrieval can be generally divided into categories based on the level/source of information operating on. Textual metadata

accompanying the data, such as title, date and creator, can be defined using a custom definition language. A number of frameworks attempt to standardise metadata with MPEG-7 being prominent in multimedia content description. Methods computing multimedia similarity using objective metadata, e.g., composer name, song title, etc. present an excellent methodology for content retrieval. The computing efficiency of textual retrieval based on the bounded definition language in combination with the unique source of objective information concerning the content make the use of metadata very important.

Still, in some cases metadata are of no use since these require prior knowledge of data that is not conveyed by listening/watching, may be unavailable (not set) and have limited scope due to usage of pre-defined descriptors. In these cases, content-based similarity has been under extensive research in a number of multimedia areas, focusing on features extracted directly from the datum content. These features express different attributes of the signal containing the datum that similarity can be based upon in order to retrieve content.

Despite content-based methodologies cater for query-by-sample, such methods base their distinction capability in the selection of descriptive features as well as the associated distance function. It is very common a phenomenon that features and/or similarity function may not adhere to the characteristics required by users, thus diminishing the resulting efficiency of the retrieval process.

Contextual information is of great importance in similarity definition in all-human perspectives. Web 2.0 social services have offered unparalleled amounts of contextual information to "all things webbed" through the practice of assigning free textual labels (tagging). Bearing in mind the subjectivity of multimedia similarity and the nature of user assigned tags on data, it comes as no surprise that methods measuring multimedia similarity based on tags are in some cases reported more accurate than metadata or content-based methods (McFee, Barrington et al. 2010).

Rich as it may be in contextual characteristics, the information provided by Web 2.0 social services is known to present a number of disadvantages (Lamere 2008). Phenomena such as the "cold start" of new and not very popular data that have none or limited tags to work with, issues concerning synonymy, polysemy and noise of the assigned tags as well as tagger bias towards content preferred by young, affluent, and Internet savvy taggers affect enormously the effectiveness of this source of contextual information.

Accordingly, methods that integrate the previously mentioned methodologies of retrieval need to be devised in order to cope in an fully multimedia environment such as an interactive internet-based TV station since content retrieval is a key process. The integration of the methodologies will see that the effectiveness of the retrieval process will be ameliorated or at least retained in any case of user preference query or data form availability.

**Transient Data.** As far as the live events are concerned in this work, broadcasted data are confronted as streaming data/time-series received from a feed. Thus, data is modelled best not as persistent relations but rather as transient data streams. In that sense, broadcasted content shares a number of common characteristics with streaming data such as being time ordered, data arriving in segments at an unknown incoming rate and data storage/post-processing is not wanted/possible but instead an "on-the-fly" processing is required. Thus, methods utilised for similarity induction should be incremental in order to deal with memory limitations as well as high response time requirements. Moreover, streaming data methods are required in order to satisfy the

need to use continuous querying, the scenario where a user receives data from a specific feed while a service monitors the remaining feeds in order to ensure that no other feed is more similar to user requirements, in which case the user would be notified.

Furthermore, traditional information retrieval persistent relation models do not require a method for the identification of content semantic boundaries, as each section's boundaries are clearly defined from a container file in the database used. Accordingly, if traditional retrieval methods are used in a data stream model, search for similarity cannot be stopped given that content/datum is early found not to be similar as no means of datum ending is provided therein.

Research in this direction is still very limited (Kontaki, Karydis et al. 2007; Ying, Beng et al. 2008). Nevertheless, the incorporation of such a capability in the proposed interactive internet-based TV station will be able to support the content selection in two of the fundamental levels of difference between the proposed station and WebTV, that is the provision of content search in live events as well as for more than one concurrent cameras (streams).

**The Role of Metadata.** The novelty of the current case study focuses mainly on the lack of content pre-programming. We focused on the essence of MPEG-7 in terms of content representation in our implementation, particularly as it was necessary to furnish the user with the flexibility to navigate semantically across the content. A typical example would include searching of semantically related works between different artists, in an attempt to artistically and emotionally describe with the use of video art selected notions such as "love" and "happiness" (Hansen 2004). One example that may be replicated under the current system is the categorisation of the works of a single artist in time, similarly to examples found on the WWW (Johnson, Shoopman et al. 2010). Under the current case study, another educational use may be the evaluation of the progress of a student-artist by viewing the published works in chronological order.

In order to achieve this functionality descriptors are entered in a descriptor scheme (Caschera, Ferri et al. 2007), forming an informal yet dynamic description definition language, as it is user-defined. Artist that upload a new video to the system are allowed to set the descriptors and the descriptor scheme of their choice. Other artists may choose to employ the schemes and descriptors already entered in the system, through drop-down menus, or create their own. In this respect we allow each creator to express their views and describe their content using their own customised expressions, which may not fall under an existing language vocabulary. There are instances for example that words such as "wooooooosh" and "ouch" are utilised to describe sounds within uploaded movies that alternatively would need to be described using many more descriptive words (Nack and Hardman 2002; Sivashanmugam, Verma et al. 2003). Once entered into the system these are stored under the underlying XML description scheme. Note here that although we focus on accurate representation, the solution is to allow each creator to create their own vocabulary, a fact that allows semantic links to be made across the majority of terms. As this implementation is quite new, it is necessary to mature in order to evaluate its performance in the long term.

## 3.2 User Expression in Web 2.0

Web 2.0, following the analogy of software development numbering practice, refers to the evolution of Web 1.0. The key characteristic of the proclaimed evolution is the switch to interactivity in terms of interface, collaboration in terms of production and the centre-role placement of the website users in contrast to their previous passive character. Under the collaborative character previously mentioned, also lies a significant characteristic of the evolving web, which is the synchronous one-to-many and many-to-many communication capability of Web 2.0.

The amalgamation of Web 2.0 technology with the cultural domain affects all production, distribution, presentation, preservation and (re)utilisation of cultural expression. Cultural institutions are at a crossroad as to how prepare for the new "wave of participation" that seems to be unavoidable. Reorientation of the institutions is necessary as the common practice of cultural activity through delivery of information reroutes towards an exchange between institutions and users.

Moreover, the roles involved are changing as well: all users, patrons, experts, customers, producers etc involved in cultural activities are changed into participants, with their participating character stretching from consumption to interpretation or even contribution to institution artefacts. In addition to the obvious advantages that lead to this change, the enormous momentum of social networking services, the ease provided by e-services in contrast to their non-virtual counterparts as well as the epic scale of data included in their collections is putting additional pressure on institution for the adoption of similar practices.

In an attempt to categorise visitors of a museum, Mutanen (Mutanen 2006) came up with a generic classification for cultural institutions and their output audience. Accordingly, four categories of audience types are identified based on their relationship with the output of the institution as well as their participation - expression towards the output. Thus, the first category is titled "reactive consumption" and refers to the simplest and most remote case towards any participation, in which the target audience of the output is solely consuming. Advancing a little the level of participation "proactive consumption" implies that the audience has made some research on the output to experience and thus actively acquired information on the output. At the third case, "producing for private use", the audience is materialising the experience of the output by means of talk, text, images or even video, though for a private use. At the final category, "producing for public use", the proclaimed relationship includes purposeful sharing of the experience of the output the audience gained with others by reviewing, posting online or even tagging.

Nevertheless, many issues remain to be addressed (Middleton and Lee 2007) until the interactivity offered by Web 2.0 advances can be effectively put into practice by cultural organisations. Some of such key issues are (a) the media convergence based indistinctiveness of the institutions' web 2.0 services when lending applications or characteristics from other institutions as well that is based on studies of user preferences, (b) the capability to complement the authoritative information assigned by the creator/institutions on products by the collaborative wisdom of the web users, a.k.a. "crowd sourcing", can alter the perspective of presented products for better or worse, (c) the potential of audiences to furnish information to objects presented in a web 2.0 service of a cultural institution proves to be quite an issue: e.g. what may have began as an image gallery can soon become a conversation under the auspices of the Web 2.0 service, (d) the encouragement of user contribution to descriptions and

perspectives of products requires new provisions to be made in order to ensure correctness of such an invaluable resource.

### 3.3 User Interface Design

When examining the organisation from top to bottom, one is introduced to the central menu of the interactive station. The web address registered (imediatv.eu) that displays the latest system version, clearly defines the objective of the service, while the logo is self-informative. The options offered at this stage are shown in Figure 1: "Interactive TV", "News in Text", "Program", "Video Archive", "User Settings", "Submit your Content", "BackOffice Access", "Contact Us".



**Fig. 1.** Central menu choices of the internet-based interactive TV service, enabling information and interactive access to all features to the user over the web interface, through a unified web-based CSS animated menu.

User interface design was based on the initial user requirements analysis which indicated that although interaction is the main program driver, a user transcending from traditional TV medium to Interactive TV would find this experience increasingly demanding, a major factor of non-use & non-adoption phenomenon. As a result, a principal design choice introduced is the provision of the default user with a pre-determined program, displayed under the "Program" option, that automatically displays the chronologically newest stream that is added to the system, while at every stage the user is presented with the option to select an alternative stream via keyword (content-context) selection. Upon selection of the "Interactive TV" option the player initiates and a supporting window is displayed offering additional information about the stream displayed together with the related keywords.

# 4 Enabling interactive content licensing for live broadcasts: practical and legal issues

As already mentioned, broadcasting content within this web-based TV service covers pre-recorded material (on demand) and live events. Under the legal context, when it comes to making available pre-recorded material to the user which includes copyrighted works, the copyright holders' authorisation has to be obtained since such an act falls within their right to communicate the work to the public or to authorise the so doing under Greek Legislation (Articles 3(1)(h) & 1(2), Law 2121/1993). In the case of live event broadcasting, authorisation for the online communication of copyrighted works to the public, in our case through an Internet-based TV service is also required (Article 3(1)(h) & 1(2), Law 2121/1993) (Stamatoudi 2009; Marinos 2004).

Having described the advanced functionality offered by the iMediaTV service where the live program content may be affected and altered interactively in a spontaneous manner, we propose the development of a digital networked database enabling online and direct content licensing. In that respect, direct licensing of copyrighted works may act as a useful tool that benefits copyright holders, producers and users, while it permits freedom of expression to interactive new media artists. The presenter/performer will be permitted to select material stemming from an open content pool offering customised licensing services for multiple use scenarios. For example, a user may interactively provoke the presenter/performer to create a derivative new media artwork based on the combination of existing ideas and works that need to be licensed before its creation. Accordingly, the database is used to link the presenter/performers' request to the copyright owners who have submitted the content to the database, and make sure that their licensing and cost conditions for the use scenario in question are met. The database functionality offers a series of services to the parties involved, which are described below.

Copyright holders are allowed to upload and register their content, use-conditions and royalties with the system. Completion of the registration process enables users to browse and select items from the database. When content is requested, then the system matches royalties with type of use, calculates charges where applicable and requests payment from the requesting user. After transaction is completed, content is delivered to the user, while the copyright owner is informed about the transaction. The user may alter the conditions and royalties declared at any point, and the system is updated instantly.

Direct licensing has already been introduced in the U.S. as a copyright licensing scheme for music, which creates a "one-to-one relationship" between the copyright holder and the end user of a copyrighted music track without the interference of any collecting society. Where the copyright holder is a member of a collecting society, there is still the possibility of engaging in direct licensing (Buffalo Broadcasting Co v. ASCAP, 744 F. 2d 917 2nd Circ. 1984). Such a license is granted for uses that are specifically defined, such as usage of the music track as background for commercials or its usage with other audio and/or visual elements, for instance, *see* www.uniquetracks.com and www.iamusic.com. In other words, users will be allowed to "exploit" any of the works in the collective's repertoire upon payment of a fixed fee without distinction as to the actual works used (Du Bois 1989).

Nevertheless, given the complexity of the implication of intellectual property rules on interactive media, some important issues such as the authors' moral rights or the monopolistic/dominate position that collecting societies have created within their

territory should not be underestimated. Despite the fact that according to the Greek copyright law, it is at the author's discretion to assign the administration and/or protection of all or part of his economic rights to a collecting society (Article 54 (1), Law 2121/1993), the majority of authors prefer this scheme as they find it most effective for defending their interests. Besides, affiliation is often unavoidable with respect to those rights that by nature or statute cannot be administrated alternatively, for example under the specific cases where collective management is mandatory: (Articles 54(2), 57(8), 5(3), 18(3)-(11), 49(1)/(4)/(5), Law 2121/1993).

An interesting perspective that may offer an effective development for the proposed direct licensing scheme may come from the open content environment. It is only recently that a direct licensing platform, named "FAIRMUSIC", was established in Greece. Its available repertoire consists of musical works coming under the creative commons or content free of rights auspices and works of copyright holders who have not assigned any rights to a collecting society in Greece or abroad. Commercial licenses are obtained by paying fees for specific uses, namely "background music licenses" and "music licenses for multimedia projects", *see* www.fairmusic.gr. Despite this early attempt, collective management is still deemed a practically more viable choice (Marinos 2004).

The licensing database which we propose is an online per-work structured platform where copyright holders can directly submit their works, be it music or video, and define the specific uses allowed to the users, either for personal use or communication to the public (commercial) purposes including webcasting. Subsequently, users will be able to look for the work they are interested in, pay the relevant fees and lawfully obtain a relevant license of usage according to the pre-determined conditions. It may also include works under creative commons licenses or even works free of rights (e.g. due to the expiry of the term of protection).

When communicating musical works to the public (as with broadcasting or webcasting), it is common practice to obtain blanket licenses from the relevant collecting societies which cover a wide range of works in order to engage in the legitimate transmission of the specific copyrighted works that each society has been contractually assigned to administer (Marinos 2004). Nevertheless, therein lurks the risk of not using all the licensed material while having already paid hefty royalties. Such a risk can be eliminated within the proposed licensing database scheme since the user will be able to identify the particular work interested in and get a license for the particular use of this work in a simple and quick way.

Accordingly, such a database will enable the broadcaster of the aforementioned Internet-based TV service to communicate to the user "right on the spot" any requested copyrighted content for which the former had not already obtained a license.

## 5 Conclusion

This work has presented a series of design, implementation, usability and legal issues that arise when developing an experimental web-based interactive TV service. An interactive broadcasting platform has been constructed using existing individual components and technologies, open source systems and portals. From the computer science perspective, the system is designed to be customisable, platform independent and expandable, while a common XML-based database of content is used to synchronise and relate between the applications. New services may be easily implemented, enriching the end-system functionality.

Great interest lies in the methodology employed to interact with content, enabling the same system to simultaneously accommodate various interaction types: users may choose to watch the program without interaction, while at any stage they are able to link to other content of interest or influence live broadcasts via the bidirectional communication features supported. Content retrieval is discussed since it is a challenging and open issue, particularly for non-linear content with special presentation requirements. Moreover, the change of role of users' due to the interactive features offered by the proposed service from consumers to participants is an open issue addressed by this work. Integrated media access, user participation, a uniform user-interface, dynamic content-access and open standards summarise the main factors that render such systems competitive and cost effective. Our paper concludes by proposing a direct licensing platform for interactive multimedia and interactive new media artwork.

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