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Interactive movies: Guidelines for building an interactive video engine

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Abstract – Movies are a part of our everyday life, just as the internet is changing the way we work, play and entertain. But what if you put the two elements together? This paper explores how interactive videos work, and proposes guidelines on how to build a modular video engine, based on an experimental implementation of an interactive movie named Maya.
Keywords: interactive, online, movie, multimedia, advertisement, video, behavioral tracking

I. INTRODUCTION

Interactive movies combine two powerful trends that coexist in our times – compelling visual storytelling and the power of interactivity. Video and its potential for engagement and interactivity have been studied for education purposes by researchers, but there was rarely interest from the academia for entertainment and marketing uses. There is still ground to be broken in the areas where the two converge, and there is precious little information on how to make a successful interactive movie.

This article draws upon an experimental implementation of an interactive film named Maya, written and produced explicitly for interactive user-engaging implementation, built modularly. Based on experience and insight drawn from the implementation and results of this experiment, the authors propose guidelines for building a highly interactive video engine, that would be scalable and adaptable to a variety of scenarios, and that would also allow easy insertion of advertising messages.

II. CONTEXT

A. *A brief history of interactive video*

Humans are naturally inclined for storytelling. The values of the ancients that existed before the industrial and information revolutions were successful in crossing turbulent times to find their way to us via oral culture and visual narratives such as paintings and frescos. The invention of photography, and subsequently, the motion picture devices led to a new type of storytelling, using video. Until the emergence of computers, the recording devices were linear, leading to a sequential display of the narration that would last generally up to 3 hours.

Digital Video Discs (DVDs) changed this, introducing a degree of user interaction with the video narration, the user being capable to jump between key points of a movie or watch additional features such as trailers, interviews or making-of videos on demand, as long as they were stored on the disc. Still, even for the recent introduction of extended-capacity Blu-ray discs, the optical disc medium is limited with regards to size of content that can be fitted on a disc, and it doesn't allow any user tracking. Also, the cost of authoring and distributing content on an optical are higher than the online alternative

Due to its very nature, the internet provides an almost endless array of options for implementing a fully-interactive experience. The setback of needing a computer with an internet connection is slowly diminishing because of the gradual adoption of IPTV. Since the mass-introduction of internet-connected TVs at the Consumer Electronics Show in early 2011, this trend towards true web-like interactive content will likely be accelerating as millions or internet-enabled TVs are expected to be bought in the next years [1] to complement the existing media center boxes already existing in the consumers' living rooms. With the sharp rise in smartphone usage and their convergence with TV and the internet, and with video as content king, future applications will need to be not only interactive, but also platform-agnostic.

B. *Research on interactive video*

Despite initial drawbacks of early interactive video projects [2,3], there has been a continuous interest in interactive video, as research recognized its potential for powerful impact in transmitting a message [4,5], but technology had not matured at that point. Research was channeled into infusing interactivity into a video clip via metadata in the form of annotations as XML external files [6], or as information contained within the actual movie, as in the case with MPEG-7, a multimedia content description standard [7].

IPTV began fusing the worlds of WWW and television, introducing a good degree of interactivity and user-centrism [8]. This interference led to the disruption of top-down media delivery model, as the user became more actively involved in the media-

viewing experience, a phenomenon closely observed by researchers. A resulting 2009 study by Cesar and Chorianopoulos examines the viewer from three standpoints: as a media creator-editor that can add value to content, a social distributor of content within his peer network, and as TV director with the possibility of browsing and customizing his viewing experience [9], the researchers recommending further democratization of the media experience.

The need to build adaptive rich media applications was documented in several projects [10,11]. For video advertisements too, studies point out to the benefits of a personalized video ad viewing experience that matches users' preferences [12,13], to maximize the impact of promotional messages.

Social implications of interactive TV have been studied in various forms [2,11,14], as it was recognized that social interaction does play a role in the media consumption habits, enhancing the video experience at the cost of attention [15]. Other methods of user tracking were employed to determine engagement with a web video based on the interaction with video controls, time spent watching and other similar data - the SocialSkip project [16].

But the promising development is produced by a recent multi-platform project called NeXtream [17] shows similarities to the object of the current paper, with a proposed concept that includes user interaction, social features, user-tracking and adaptability, with a prototype implementation for iPhone and AppleTV. While the concept is excellent, the system doesn't allow for interactivity within the video content, and the advertising remains defined only in theory.

III. THE MAYA ONLINE VIDEO EXPERIMENT

Choices: Maya's interactive adventure was launched in 2008 as proof-of-concept for an interactive movie. It was written and produced modularly, each clip being dependent on previous decisions. There were 11 decision points where users had to take explicit choices, but there were also random choices and co-dependent events wired-in. Decisions were presented as pop-ups, while the movie paused. Users' choices were stored in the database for reporting and tracking. Also, the user was able to skip through the movie using the navigation buttons, the 11 decision points acting as keyframes for the movie. Play/pause/stop/credits buttons were also employed.

Fig. 1 – the Maya online video project – user choices

We've also experimented with product placement, both in the form of direct user engagement (the user had to chose on the clothing the main character was to wear, and within that choice he was given the option to learn more about the real-life product), as well as a few less-intrusive hyperlinked "hotspots" from the video clip itself. These clickable hotspots were programmed into the interactive movie, so that users were able to click on elements in the set (posters, billboards were used as proof-of-concept) to be taken to other pages with more information related to the particular element that was clicked.

Fig. 2 –Interactive hotspots in the movie set (ad placement)

Audio advertisements were also employed, in the form of 6 randomly selected radio commercials as the main character wakes up. Social features were also implemented in basic forms, in the manner of sharing tools and a rating bar.

The pieces of video, decision points and interactivity were scripted together in Adobe Flash, using Actionscript. A PHP script also was employed to serve as a bridge between the Flash application and a MYSQL database responsible of storing user information. The resulting multimedia project, in Flash format, was placed online for several months, while usage data was collected and processed.In total, there were 31 video clips of variable length and 6 audio clips produced for this project, as shown in Fig. 3. All videos were linked external files, so if there was a need to reedit parts of the movie, for instance, to refresh a product placement scene, a simple overwrite of that particular video clip would suffice.

Thus, a 3-6 minute interactive movie resulted (the particular length varied according to user decisions). The amount of combinations for the video modules led to 4096 versions, but the fact that 6 audio commercials were alternatively played, randomly, the result can climb to a staggering 24576 combinations, in theory. However, dependent decisions caused by production cost constraints scale this number down to several hundred real-world possibilities.

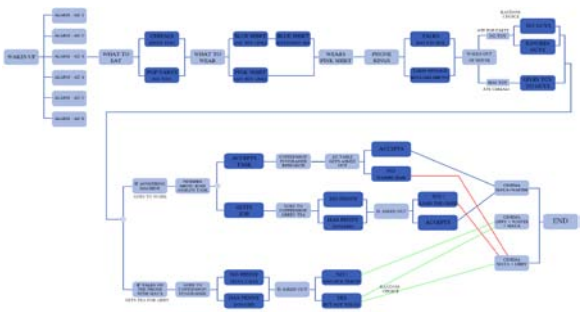
Fig. 3 – Structure of prototype film. Dark-blue cells are decisions

Tracking data for a few months revealed there were 33 users from 13 countries on 3 continents that interacted with the movie, of which 13 (39%) reached the end of the movie. Results also show that there was a good percentage of interaction with the advertisements embedded in the movie (39% and 88%), even though there seems to be a significant variation due to different types of ads (clothing versus a feature film). This data sends positive signals for using such a medium for marketing messages. For audio ads that were played as wake-up alarms, there was no real way to measure impact, aside how many times they occurred (82%).

Table 1 – User-tracking results

Actions tracked	**number**	**percent**
Users that interacted with the movie	33	100%
Times the user reached end of movie	13	39%
Clicks on physical object inside the video frame (poster)	29	88%
Clicks on product placement ads (clothing)	13	39%
Radio ads played	27	82%

Aside recording choices, the *Choices: Maya* project also stored IP addresses for geo-location purposes, as well as the access date and time. It did not, however, record the amount of time spent within the application, or the interaction with the navigation elements (play, pause, forward, stop, credits).

Table 2 – Data stored for a user

date	ip	finish	alarm	choice1	choice2	choice3	choice4	choice5	choice6	choice7	clicked_ad
11/23/2009, 12:28	129.219.189.212	yes	commercial 3	poptarts	pink shirt	picks up	no guys out	leaves penny		postpones	none
10/28/2010, 08:42	193.226.10.119	yes	commercial 1	cereal	pink shirt	takes me	ignores guy	leaves pen	takes job a	excuse - wi	pink blouse
10/19/2010, 11:11	145.53.140.66	yes	commercial 4	poptarts	pink shirt	takes me	no guys out	leaves pen	takes job a	excuse - wi	blue blouse

Another downside of the *Choices: Maya's interactive adventure* project was the fact that much of the code that determined choices was wired into the flash source of the project, and even though the individual video clips could have been overwritten, the structure of the movie remained the same, without any scaling perspective.

IV. PROPOSED GUIDELINES FOR DEVELOPING AN ONLINE VIDEO ENGINE

Though there was a relatively small sample of collected data in the *Choices: Maya* project, one can draw several conclusions from this study, and these conclusions can serve as guidelines for developing such an interactive movie.

Firstly, the entire application needs to be stored online rather than on physical media, to allow for an open-data model and an always-up-to-date experience. The widespread adoption of HTML5 with its native support for video demands that all such interactive applications are to be deployed in this format rather than Adobe's proprietary Flash engine.

In order to achieve maximum flexibility for an easy-to-adapt, scalable interactive movie engine, the best approach would be to use object-oriented programming, combined with external editable configuration xml files that the interactive movie producer can modify to add choices on the fly, or create alternative routes to the end. External videos and audio clips need to be employed, for easy access and overwriting, if needed. This modular, scalable structure should prove flexible enough for a multitude of deployments.

Another derivative of this flexible structure would be to allow users to upload their own video pieces and create their own interactive film. This interactive movie engine would relieve the average user of the need to do advanced coding, leaving him to upload the videos and edit configuration files to define his own production.

Secondly, collecting usage information as detailed as possible should be paramount, in order to properly understand the habits of the users and improve services. This would be particularly advantageous if one builds a library of such interactive movies, where the choices made by a particular user in a previous movie would influence the type of content shown to him next. The potential of semantic video can also be considered here. Also, collected data would serve as valuable insight for movie producers with regards to audience trends.

This data collection would imply both user-tracking (choices, clicks, time spent, interaction), and user feedback (ratings, reviews, social aspects).

Also, the interactive movie needs to provide options for a viewer, either engaging himin lean-forward experience where the user is actively participating in the decision process, or taking a more lean-back television-like approach where the user can decide up-front on a „type" of a movie to watch (action, happy end, random-choices), with the possibility of overriding at any time the resulting generated movie.

Beyond choices, user interaction can be extended to elements in the video frame. While this task of defining hyperlinks in the video can be quite time-consuming (one needs to specify the exact area of the image that is to be hyperlinked and add the in/out timecode) until future technology emerges, it can yield excellent results with regards to enhanced product placement. It would also add value to the production by placing it in the larger context, extend the experience beyond the film. The danger of this approach is obviously of viewers losing interest in the interactive video due to more interesting findings, but this fact can actually constitute a positive result from an advertisement standpoint.

An additional issue to address is the legal framework that protects the privacy of the individual. The viewers of *Choices: Maya's interactive adventure* came from countries on 3 continents – Europe, North America and Asia. While the North-American legislation tends to be more permissive about the collection of personal information for behavioural tracking, the EU legislation is significantly more protective of the European citizen's personal information, while other regions of the world have

other restrictions [18,19]. Due to these geographical differences in legislation and the pervasiveness of the internet, it is recommended to implement an IP-filtering solution to block access from legally-problematic countries (which can also be coupled with geo-protection for copyrighted material). An even better alternative would be to build an upfront online form, requesting permission to track behavioral data from the user.

V. CONCLUSIONS AND FUTURE RESEARCH

This article presented an overview of current trends in interactive television. It then presented an experimental model called *Choices: Maya's interactive adventure*, an interactive film that placed the user in charge of the narration, employing user-tracking to create a detailed profile of user choices and preferences and resorting to interactive ad-placement, both visual and audio. It then presented a set of guidelines for producing and deploying an interactive movie, focusing on generating a good degree of user participation and a pleasant experience, while at the same time exploring business opportunities for in-media advertising that would yield optimal results for ad companies.

An important direction for future research is evaluating how a lean-forward, decision-taking approach can be combined with a semantic approach, where the interactive system starts serving customized content that is adapted to the preferences of the user, once a certain acquaintance of user preferences and habits is obtained. This would lead to a more adaptable interactive system that is more sensitive to user location and context. A good balance between active input versus an adaptive automated experience based on media semantics should be researched in following studies.

Another area to explore would be improving the effectiveness of advertisements in such an interactive production. This would be of tremendous importance for the entertainment industry that relies heavily on the advertising model for generating revenues.

Another opportunity would be to practically implement an engine for user-generated interactive videos, as well as finding more cost-effective ways to produce interactive movies.

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