Tri-Story as "Intuitive Cinema"

Interactive Storytelling based on Physical Action for Multi Screen

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ABSTRACT

This paper proposes "intuitive cinema" – a new form of interactive storytelling, which emphasizes user motif and viewpoints, and implements its cinematic expressions based on immersive quality and audience's viewing methods. We use the quality of physical action that is made possible through a multi-screen system, and use it to approach a novel interactive storytelling method. From this concept comes "intuitive cinema", that allows its viewers freedom to watch the movies from their personal viewpoints. The content consists of 3 channels of live-action motion pictures, and the system applies interactive displays to realize the content "Tri-Story" based on the concept of intuitive cinema.

Categories and Subject Descriptors

H.5.2 [**User Interface**] : *Theory and Methods*

General Terms

Design, Human Factors, Theory

Keywords

Interactive Cinema, Multi Screen, Interactive Display, Interactive Storytelling, Physical Action, Motion Pictures, Max/MSP

1. Introduction

As far back as the silent movie phase, moviegoers have been submitted to a passive way of film appreciation. This attribute does not change even after the phase of cinema switches to color. Films are shot and edited, according to the will of filmmakers. All that is left to the audience is to simply sit in a chair in a movie theater, or be a potato couch in their living rooms when they are presented the films.

On the other hand, antithetical to the movies are theatrical plays. Unlike the motion pictures, stage plays allow interactions between the actors and the audience. Each audience crowd has a different reaction, and hence from the differences in their reactions actors' performance may more or less shift in correspondence. The definition of *audience reaction* relies on each audience's point of view and behavior. If there are 100 viewers in the room, it is doubtless to say that each audience has his/her own reason, or motif, that draws them to go to see the play, and thus each has his/her own point of view.

In addition, scenes of the theater plays interactively evolve in real-time have an *immersive* quality in themselves. The fact that theater experience obtains audience reaction, and immersive quality, makes each experience different in essence. Depending on which specific part of physical space on stage one focuses on, the personal viewpoint also changes as a term of output. Therefore, "viewpoint" plays an important as well as a dramatic role in the essence of theater.

Contrary to theater, films are made according to the specific viewpoints of the filmmakers on a unilateral basis. Unlike theatrical performance, a film is not likely to react to its audience's reaction. Elements of dramatic impression, such as motif and immersion; or more specifically, personal viewpoint, are all lacking in the realm of the movies. To make up the drawbacks of the movies, interactive cinema has been widely stressed over the past few decades. However, the conventional form of interactive cinema – which most commonly utilizes devices such as mouse, touch panel, remote controls, and its contents involving user intervention to change the storylines – does not give a dramatic impression strong enough to define the next generation of cinema. From the cinematic perspective, user intervention in the content only fulfills viewers' perspective on the story, it does not fulfill the standard in terms of viewer's watching methods, or giving viewers full and immersive quality to the story. In other words, it is a "partial" cinema, not one of the whole. Therefore, we propose a novel form of interactive cinema that innovates the essence of the cinema to a new system and form of content.

This novel interactive cinema obtains 3 elements of the cinematic impression: motif, immersion, and perspective, which as a whole establishes the foundation of our proposed interactive cinema. The most important element of the three is *perspective*. Setting up the viewing system so that viewers can watch the works in their own perspectives is what makes our system new and interactively defined. It is to this novelty that we have come to call the project, instead of interactive cinema, "intuitive cinema".

The concept of the project is based on the new movie watching method that we propose; and according to the new method, a best-fitted system and its contents are created. The collective term of the project is called "Tri-Story". Tri-Story consists of multiple screens and interactive

displays; and its contents work from the standpoint of interactive storytelling and the new possibilities to the system – the physical actions and functions -that come from the use of multiple screens, to ensure users' complete freedom in watching a film.

Tri-Story is consisted of 3 channels of live-action motion pictures, with 1 main screen in the center and 2 interactive sub-displays placed at the left and right sides to the user. The interactivity provided by the sub-displays has a 2-dimensional framing function, as well as a zooming function. With these provided functions, users are able to watch the movie from their own chosen perspectives with absolute freedom

The next chapter narrates the related works we have considered for our research. The topics include multi-screen, interactive display and interactive storytelling. In the third chapter, the concept of "Tri-Story" will be further described in detail. The fourth chapter explains in detail how "Tri-Story" was developed with multiple screens, interactive displays, and interactive storytelling techniques, including details to contents production and the system implementation. In addition, an evaluation and the future development of this project is included in this chapter. And finally, a summing up will be stated simply in the last chapter.

2. Related Works

Tri-Story is a collection of short films that consist of a system using multiple screens, interactive displays, and interactive storytelling techniques. The system realizes each user's unique and arbitrary viewing method, which we call "intuitive cinema". This chapter is about the related research and projects of which we have taken consideration, while addressing the specific problematic issues to each of them.

2. 1 Multi-Screen System

The most well-known multi-screen system can be said to be the IMAX system, for the concept of immersive display was developed with the birth of IMAX. In the order of IMAX series [1] → OMNIMAX [2] → CAVE [3], immersion became an issue that studies sought after. The immersive multi-screen system that OMNIMAX had built also provided interactivity that CAVE obtains. Most of CAVE's contents are concentrated in the science [4], art [5], and games [6]; cinematic contents of interactive storytelling have not yet been utilized with the system. As a whole, the multi-screen system has developed much in its immersive quality; however, the contents remain passive to the audience, and the system's advancement remains in the technological area. The contents, in other words, the unique storytelling techniques, have not yet been explored to its potential. Furthermore, due to the fact that special hardwares and large scale equipment in the system are needed to fully perform, problematic issues such as in the budget area become significant.

Of course, there are projects that, instead of large scale systems, use DVD projection or plasma displays to build a different multi-screen system[7][8]. However, these projects stress the conventional storytelling techniques and no interactive element is corresponded. Even if they use a multi-screen system, their work is essentially a movie screening, nothing more.

2. 2 Interactive Display

This section is about the use of displays with built-in sensors. These interactive displays use sensors to detect the surroundings and to get feedback on the information in detail.

Matthew Mohro's 3D Spatial Narrative [9] works with a plasma display mounted unto a axial rod, and projects motion pictures (both live-action and CG) at the direction of the eye gaze. However, the contents do not contain any story, but instead remains at demonstration video.

Kensuke Hatano et. al.'s Dimension Book [10] is able to connect real actions in the physical realm to the 3DCG objects portrayed the displays. However, detection feedback on the system's part is a pre-requisite to any action taken place; and there is no storyline involved in the contents. Moreover, because each sensor controls a single content, and all sensors are linked to one another, it is impossible to reduce the number of contents.

Shree K. et. al.'s Lighting Sensitive Display (LSD) [11] reproduces lighting directions and luminous intensity in physical space. Although this project uses an even more accurate algorithm than Dimension Book, it is only a portrayal of a demonstration on the modeling of the lighting reproduction, no cinematic quality such as a storyline is included in LSD.

The 3 interactive displays mentioned above are all high in system quality, yet ironically low in versatility. It is impossible to apply other contents to these displays flexibly. Moreover, the contents they use are all simply demonstrational contents, not unique and/or cinematic contents to fully explore the systems. MR contents such as Little Red [12] uses plot-based contents to interactive displays is a very interesting project. However, it only grants feedback to a restricted viewing method, users' arbitrary viewing behavior is not made possible.

2. 3 Interactive Storytelling

The topic of interactive storytelling mentioned in this section is based on user intervention. User intervention may involve 2 distinct devices: mouse-based interaction and physical interaction. Mouse-based interaction means user intervention takes place by using the mouse as the input device; whereas physical interaction uses GUI-based metaphoric interactions, such as the users' hands or any other physical parts of the body to operate the system.

Below are a couple of examples of mouse-based interaction contents.

I'M YOUR MAN [13] is an interactive DVD work. Users can change the storyline by selecting the choices given in a button form on the screen. The disadvantage of such interactivity is that it loses the entertainment meaning of film. By constantly giving viewers choices and asking for user intervention, the project takes the audience away from the magic of cinema. Like many other interactive cinema works, turning over the decision-making process to the audience may turn out to be a heavier weight on the viewers than expected.

ONE-PERSON TOUCHSCREEN CINEMA [14] is a project that applies touch screen to digital video installation. The interactivity in the contents works as a metaphor in reflection. A user's touch triggers fragmented plotlines and in touching the screen, users develop the storyline. This project is interesting in its use of interface, however, the interactivity is limited to the restrictions preset in the program, user freedom is not ensured.

The next projects are examples of physical interaction contents.

66movingimages [15] emphasizes its interactivity in the physical movements of the monitor. By moving the monitor, users are exposed and immersed into an interactive road movie. However, users' arbitrary watching is physically limited by the equipment set up. And the story told is a mere documentary that consists of stilled photographs.

RUN Motherfucker RUN [16] is an interactive installation that uses the action of "running" as its interactive device. Users run on the roadrunner setup in front of the screen. The contents projected onscreen changes according to the running speed of the users. Although the project involves active immersion, the content, again, lacks qualities of the dramatic impression.

Place Ruhr[17] is an interactive computer graphic video installation that uses the rotating action as its interactive device. Users are placed in the center of a rotating platform, surrounded by a large scale of circular screens. By rotating the platform, one can enjoy 360º of panoramic content that is both active and immersive. However, what is portrayed on screen does not involve any plotline, the project also lacks cinematic qualities in its content area.

LANDSCAPE ONE [18] is an interactive installation with a 4 surround screens. Users can participate by communicating with the characters that go on and off the screen. If the communication comes to a completion at one point, scenes projected on the screen change into a different one. One can enjoy not only the interactivity with the virtual characters, but the immersion of the contents itself. However, the contents itself does not contain any storyline. The interaction eventually loses purpose. The project is only a variety of interactive cinema.

Below is a quick sum up of the controversial issues in projects based on interactive storytelling.

Storytelling that involves mouse-based interaction is a typical form of interactive cinema. Its image lies stronger in the game field rather than of pure cinema. In other words, such contents are only a user intervention storytelling technique. Physical interaction storytelling, on the other hand, relies strongly on the interface of the input device. It loses focus on the contents – the interactive actions, the story development, and most importantly, users' arbitrary watching methods. However, it is worth mentioning that with both of the storytelling techniques, users are able to actively immerse into the contents. Instead of the passive movie watching provided by the conventional multi-screen system, these storytelling techniques are able to reform from the users' stand, and let the users actively participate in the contents.

3. Concept – Intuitive Cinema

Intuitive Cinema is a proposal to a new form of interactive cinema that adopts the dramatic impressions provided from film.

The dramatic impression we mention here can be defined by these 3 factors:

- Audience's motif – what motivates a viewer to watch the film.
- The immersive sensation that is made possible through real-time interactive story development.
- User perspective in terms of which specific part of the content a user watches (is interested in). This factor is, doubtlessly, based on the 2 prior factors - audience motif and immersive sensation.

The most important factor is the latter one, for it treats the first two factors as an output to serve the user perspective. The concept sets up so that viewers are given complete freedom in *how* they want to watch a movie; hence the naming, "intuitive cinema".

In embracing the dramatic impression factors, Intuitive cinema attempts to lead interactive cinema into the next dimension.The interactive storytelling involving user interventions mentioned above [19][20] are merely a variety of interactive cinema. If such projects are said to be the first stage of interactive cinema, what we are aiming for is the second stage. Like Glen Frashe et. al. [21] who propose new concepts to interactive cinema, we are not only proposing yet another new concept, but to further supplement film as a medium, we attempt another step to developing the contents and system for interactive cinema.

"Tri-Story" is a content produced solely for the developed system of intuitive cinema. "Tri-Story" studies all concepts and structures of prior works, and develops a whole new set including multi-screen, interaction display, interactive storytelling; and in taking advantages of the physical actions made possible through multiple screens, we use new interactive storytelling techniques that allows users complete freedom in their personal ways of watching a movie.

The conventional multi-screen system, be it interactive, does not fully realize the essence of storytelling. In contrast to that, "Tri-Story" reconsiders the meaning of multi-screen, and applies it as a device to interactive storytelling. In other words, the system use multiple screens,

but consciously uses each uniquely and individually. From the content point of view, by using multiple screens, multiple interrelating storylines can take place at the same time.

Another key point of our multi-screen system is the factor of *simultaneity*. No matter how many stories are told in the form of conventional films, only one storyline can take place. "Tri-Story" makes multiple storylines possible by using multiple screens; in this case, 3 storylines on 3 separate screens.

The conventional interactive displays are not versatile, nor do they perform contents with utmost dramatic impressions. On the other hand, "Tri-Story" performs multi-purposes, and utilizes interactive displays to fully extend storytelling techniques in the cinematic realm. The versatility of "Tri-Story" is that it does not use special hardware, nor does it need large scale systems. In addition, it adapts easily to all genres and types of contents.

Moreover, we believe that both the contents and the system be equally important in a project as such. For instance, with the IMAX system, the current existing film shooting system does not show the system at its best. Along with a new system, a new set of contents is necessary, hence a new form of interactive cinema in whole can be made possible.

The conventional interactive storytelling uses physical actions as an interactive device. Even though users can be actively immersed into the works on screen, the quality of dramatic impression remains lacking in the contents. "Tri-Story", on the other hand, not only uses physical actions as an interactive device, it also stresses the importance of the contents, and reforms users' watching behavior from an objective point of view to that of a subjective. User freedom in subjective watching can be said to be the key to our reform.

We have made "Tri-Story" in order to develop both the system's and the content's side of intuitive cinema. In the next chapter, the developed system and the best-fitted contents produced will be explained in full detail.

4. Tri-Story

This chapter describes the system and the contents "Tri-Story" that is based on intuitive cinema. The abstract of "Tri-Story" is mentioned in the next section, the content will then be described in detail in the second section. The third section illustrates the system of intuitive cinema; the fourth section gives a full analysis of the proposal, and finally, future prospects are described in the last secion.

4.1 Abstract

Tri-Story uses the physical actions made possible through multi-screen systems and created its contents accordingly, especially in the aspects of elements such as interactive storytelling, multi-screen, and interactive display, in order to achieve viewing freedom (or subjective viewing) on part of the viewers. The content – Tri-Story – consists of 3 channels of live-action motion pictures, one being the main screen, and the other two the interactive sub-displays (Fig1). The system does not simply obtain the "multi-screen" qualities, but each screen acts as an important part of the whole. The interactions of the sub-displays have a 2-dimensional framing function and a Z-position which controls the zooming in and out of the contents. In addition, it enables one to focus at a certain part of the content and zoom in to it specifically, in order to switch between different scenes or stories.

Through these interactions, viewers are given the freedom to choose how and what they want watch from the contents given on screen. They can zoom in to their favorite actor, or have their own intentions on how they want the objects to be framed in the display. By adapting to user motif and immersive perspective, the project gives viewers the space to intuitively and freely watch the movies at their own will.

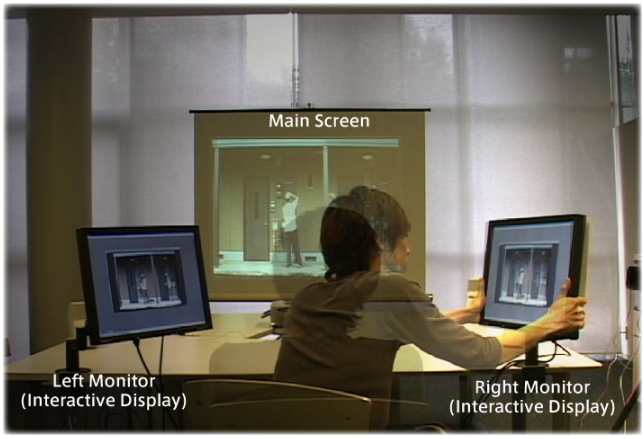

Fig1. Overview of Tri-Story

4.2 Content

In this version, three comedy stories are told simultaneously (Fig2). Each story stands independently, but can also be watched at the same time to get different perspectives over the storyline. Since the stories were created with the presumption of simultaneity, a new film production process is required. For instance, the creation of storyboard had to be calculated to its exact time, in order to show the subtle interactions between the characters among different stories. Secondly, because everything is shown in real-time, the methods of directing and acting were unconventional.

4.2.1 Story

The story on the main screen is based on the occurrences that take place outside two apartments (hallway)(Fig2). The characters are a pizza guy, a young Japanese gangster, and a young Japanese girl. The main plot concerns the pizza guy, who is fervently trying to deliver the pizzas correctly while making all the easiest mistakes; the more mistakes he makes, the more depressed and anxious he becomes.

Fig2. Overview of Tri-Story

The left monitor shows what goes on in the left apartment (apartment 102) (Fig2). In this story, two characters take place: the young Japanese gangster, who also appears in the story on main screen, and an unknown European guy. The main plot goes that the young Japanese gangster threatens the European guy to return something that belongs to him. The European guy simply makes fun of the Japanese gangster, saying that he is of no threat to him. The further the story progresses, the more anxious the Japanese guy becomes. And eventually, takes out his utmost tactic –Natto (fermented soybeans).

The right monitor portrays the story of a couple who live in the right apartment (apartment 101) (Fig2). In this story, the American boyfriend is trying to propose to his Japanese girlfriend. They apparently are not able to communicate in their own languages, the story starts with the boyfriend practicing his proposal in his clumsy Japanese. As the story goes on, the proposal is nothing like the boyfriend had imagined, everything goes wrong and the anxiety between the two causes further stress to the characters in the next apartment as well as the pizza guy at the exterior.

The analogy between all three stories is one of the most common themes – of nothingness, detachment, loss of control, and anxiety. The plots are based on something that is unlikely to happen yet plausible, everything is acted out in an exaggerated form. The multi-cultural element only adds mocking to the ridicule of the stories, it is a cynical comedy.

4.2.2 Multiple Simultaneous Chain Reaction

What makes the contents different from the usual movies, is the component of multiple simultaneous chain reaction.

An example of a *multiple simultaneous chain reaction* in "Tri-Story" is of the following:

The American guy in Apt. 101 tries to speak to his girlfriend, who is obsessively absorbed by what is showing on the television (which is showing a totally meaningless content in the most obvious way). He turns the television off to get her attention, when she screams tragically at the sudden power-off. Her scream, on the other hand, freaks out the pizza delivery guy, who just a few seconds ago knocked on their door to deliver the pizza. At the same time, the young Japanese gangster in Apt. 102 is trying to get the European guy to take his threats seriously. The girl's scream abruptly interrupts a series of his routines of threats to the European guy. The gangster is purportedly annoyed and insulted at such interruption that he stops the threat routine for a second to knock on the wall (which connects to Apt. 101) and yells for her to quiet down. This action of the gangster's, however, triggers more ridicules from the European guy, who laughs relentlessly at the gangster, and feels no intimidation that he is being tied up and threatened.

This whole action-reaction sets fire to the next story development, where tension is continuously increasing, from the built-up viewers know that it is only a matter of time before everything is bound to explode.

4.2.3 The Production

There are three major differences between the production process of Tri-Story and the conventional filmmaking process: the story development, the shooting, and the direction as well as acting performance. These differences will be further analyzed in the context below.

First of all, the story development…

Screenplay writing also turns on a new stand. An infinite number of stories can take place with this system. Multiple stories can be created and written unto the same screenplay. On top of the story structure and character development, the screenplay needs to be written according to *time*. The keyword is the *timing* of events. Because every story is related to each other in the screenplay, interactions between characters of different stories are allowed. From their interactions come the changes in each story. The continuous "chemical reactions" between the stories forms *multiple simultaneous chain reactions*. Hence, it is not an exaggeration to say that the sense of time in the screenplays plays the most important role comparing to the other elements. And therefore, the storyboard would also be drawn based on precise timing.

Secondly, the shooting methods…

Contrary to conventional filmmaking, no angle set-up, or cuts between shots and scenes are necessary. Audience no longer has to watch what is given to them and be limited enough to accept them in whole. Instead, viewers have a choice of choosing the story to watch, or a specific character to focus on, or even the subtlest items in the scene (ie. a lamp, a chair, the floor, the poster on the wall). Because of this freedom on the viewers' part that the project aims to achieve, a *surplus* of content is necessary. For instance, in conventional films, a scene where two

characters are having a conversation would usually involve the cutting back and forth between the characters, a close-up shot of a character's reaction or the speaker's facial and body expressions, a medium or long shot of both characters in sight… etc. All these shooting methods become obsolete in this content. Instead, the cameras try to catch as much information as possible, to offer viewers more than enough contents to look at. And since cuts are no longer necessary, cameras stay stationary during the whole process of shooting once they are fully set up.

Lastly, the direction and acting performance…

The acting method of this project is also different from the conventional filmmaking process. The movie content requires theatrical acting method, to exaggerate the body language of the characters. The more implausible the actions, the more it is imposed. In fact, because everything is taken in one take – no cuts, no shot changes – acting rehearsal takes up a considerable amount of time compared to the actual shooting process.

The direction, in addition, requests not only an usual movie director's craft, but also the timing of all events in the storyline is an important element.

Theatrical acting and directing is used to produce this movie.

4.3 System

The system of Tri-Story (Fig3) consists of 3-channel live-action motion pictures and 4-channel sound. One of the three channels of motion pictures is projected unto the main screen, and the other two channels are projected on the two interactive displays positioned at the left and right to the main screen. The functions of the interactive displays are framing on the X- and Y-position and zooming in and out on the Z-position. The interactive displays can be physically moved up and down (tilting), left and right (panning), and push and pull (zooming); through such interactions, users can pick their favorite point of views, and/or angles to watch the movie. These two interactive displays are installed by flexible arms on the table right in front of the user.

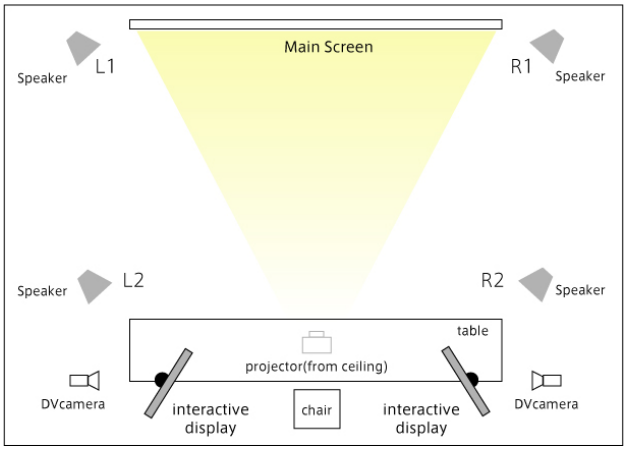

Fig3. The Setup of Tri-story

The contents projected on both the main display and the sub-display, because shot with a DV camera, have an original resolution the same to that of a DV camera's size, which is 720x480 pixels.

All of the interactivity is controlled by 1 PC unit (Pentium 4, 2.8Ghz). In addition, Parhelia/256MD DDR PCI of MATROX was used for the trihedral image displays, and MAX/MSP+JITTER was used for application development.

4.3.1 Interaction – Zoom in/out

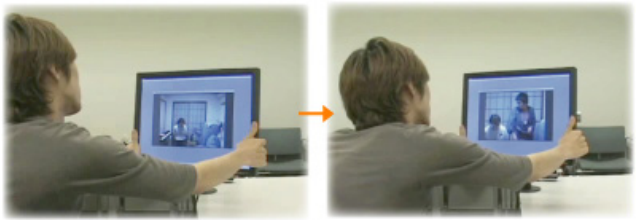

Fig4. The Zoom Function

A zoom in/out function is made possible on the 2 sub-displays (Fig4). A digital video camera is set up at the back of the display, and an ultrasonic sensor is fixed to the upper part of its lens. This installment makes the distance between the display and the camera detectable.

To be precise, the sensor detects a distance value of 0 ~ 120cm. The value is then divided into 6 segments at 20cm each, to bring out the zoom in and zoom out functions.

Before the sub-displays are being moved, at the position of its original setup, they project the same contents as shown on the main screen (Z-position at x1). When the sub-displays are pushed to a 1-segment zoom, the content enlarges 1.5 times its original size. At this state, by aiming the displays at the apartment doors on screen, and zooming in another segment further, users can break in and enter the apartments. Whichever apartment one enters, the contents shown on the screen is at its default size. By pushing the display forward another notch and so on, the pictures on screen can zoom in at 1.5, 2, and 3 times its original size (Fig5). The relationship of the assigned zoom value, the physical distance between the ultrasonic sensor and the displays, and the motion pictures on screen is shown at the table below (Table1). To zoom out, simply pull the display out toward the user's seating direction.

Table1. Relationship of Zoom Value, Distance between Ultrasonic Sensor and Displays, and Motion Pictures.

distance (cm)	Zoom	Content of interactive dispay	
		Left monitor	Right monitor
0 ~ 20	* 3	Apartment102	Apartment101
21 ~ 40	* 2	Apartment102	Apartment101
41 ~ 60	* 1.5	Apartment102	Apartment101
61 ~ 80	* 1	Apartment102	Apartment101
81~ 100	* 1.5	Hallway	Hallway
101 ~ 120	* 1	hallway	hallway

Furthermore, because all three short motion pictures run at the same timeline, a global lock is implemented at the interior of the application. When switching the contents between the hallway scene and the apartment101 and apartment102 scenes by using the zoom function, the system refers to the current value of the serial global lock to read the time code to precisely perform the picture-switching function.

Fig5. Degrees of Zoom

4.3.2 Interaction - Framing

The 2 sub-displays have a framing function by reading the X- and Y-position (Fig6). At the back-side of the displays, digital video cameras are set up paralleled to the display(Fig3). Infrared radiation filters are attached to the camera lenses, to detect the infrared LED fixed at the back of the displays.

An image analysis program is set up in the application, which determines the value of X and Y coordinates according to the light emitted by the infrared LED. The light is emitted through infrared filters unto the video camera's screen. The image analysis program is able to determine the X and Y coordinates (with a value of -100<x<100 and -100<y<100) to their exact coordinate points, and by applying these values, the specific fields of the contents can be hewed out to project on the sub-displays. In addition, the location of the infrared LED is completed with mirroring processing, so that if the monitor is moved to the left, confirmed coordinate points will automatically shift to the left and exhibit so on the sub-displays. Hence, the content itself also shifts towards the left direction.

The framing and zoom functions are closely associated in this system, for picture resolution on the displays is the same to that of the originally shot. When the resolution is lower than its original, it is possible to frame a specific part of the content at its default size. However, when there is any area of the content hidden (not showing) from the screen, users are coerced into using the framing function. Therefore, the system uses the same resolution as the content was originally shot. The relative measure of the movable pixel range at each scale factor is shown below in Table2.

Table2. Relative Measure of Zoom Value and Movable Pixel Range

Zoom	Pixel range	
	x	y
* 1	fixed	fixed
* 1.5	0 < x < 960	0 < y < 720
* 2	0 < x < 1440	0 < y < 960
* 3	0 < x < 2160	0 < y < 1440

As to the interactions of the hallway scene, users can enter the doors shown in the scene by aligning the two interactive displays to the apartment doors, and pushing forward to enter the apartments. To be precise, when z = 1.5 times, the pixel range of the doors still exists on display; it is by under-running its value down to 80 on the ultrasonic sensors that one can break in and enter the apartments. The pixel range of the doors at the hallway scene is shown below in (Table3).

Table2. Pixel Range of the Left and Right Doors (when Hallway Scene is set at x1.5)

doors	Pixel range	
	x	y
Left door	160 < x < 320	184 < y < 536
Right door	640 < x < 800	184 < y < 536

4.3.3 Interaction - Sounds

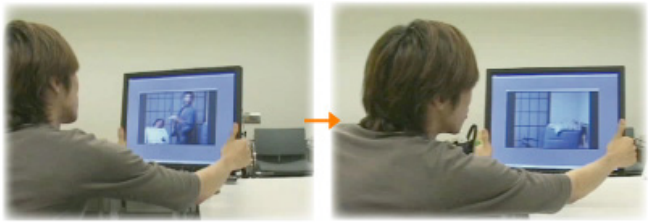

Fig6. The Flaming Function

The system of Tri-Story consists of a 3-channel live-action motion pictures and a 4-channel sound. The output of the 4-channel sound changes depending on the zooming in/out functions applied inside the apartments. According to Fig3, 1 set of speakers is implemented to the left and right sides of the main screen (L1, R1); and behind the 2 interactive displays, 1 speaker each is set up (L2, R2). At the default state, all of the screens portray the hallway scene. Both L1 and L2 plays the sound of the left channel, and R1 and R2 plays that of the right channel.

When the content on the left interactive display enters the left apartment, L1 and R1 switches sound from the hallway scene to the left apartment scene. L2 plays the left channel sound of the left apartment, and R2 plays the right channel sound of the same apartment.

Likewise, when the right interactive display shows that it has entered the right apartment, L1 and R1 switches sound from the hallway scene to the right apartment scene. L2 plays the left channel sound of the right apartment, whereas R2 plays the right channel sound of the same scene.

When both of the interactive displays enter the apartments respectively, L1 and R1 switches sound from the hallway scene to the apartment

scenes. L2 plays the sound of the left apartment, whereas R2 plays the sound of the right apartment.

4.4 Evaluation

This section will proceed to evaluate the project as a whole – both the contents and system.

Evaluations on part of the contents:
"Tri-Story" is the first content to be produced according to the system. Although it is only an experimental one, it is able to propose the production methods from screenplay writing, shooting, to acting and directing methods. Meanwhile, the storytelling techniques in regards to the multi-screen system respectively offer particular methods that are effective.

Evaluations on part of the system:
By applying ultrasonic sensor and image processing, users can directly and physically control the displays to sensing the contents in 3 dimensions. From the feedback of the information of the XYZ dimensions of the contents, our proposal – that users are offered maximum freedom to movie-watching – was realized.

Evaluations on the project as a whole:
Even though this version of the project offers a minimal of system and contents, we believe that our proposal and concept of an intuitive cinema is presented in full measure, in addition to its future potential and possibilities in sight. In other words, this project offers what the conventional cinema is not able to do. It not only elaborates on user motifs and immersive perspectives in its system structure, but it also focuses on the arbitrary way a viewer might watch a movie within the produced contents.

4.5 Future Development

This section is about the future development of the contents, the system, and the project as a whole.

From the content's perspective, a new set of filmmaking process took place. From screenplay writing, shooting, directing and acting method, the aim of the content was to be as accurate to the system as possible. In the contents produced this time, by moving the display towards the doors, viewers can enter the apartments. From there, the system allows further zooming functions, so that viewers can freely watch any detail of choice. To allow even more viewer freedom, each detail in the production part is important.

From the system's perspective, the current version is considered a prototype. The next step is to even further improve image processing based on ultrasonic sensors and cameras. In the future, AR toolkit will be used to boot up the accuracy in sensor detection. In addition, improvements on the sensors will be sought in order to detect all kinds of movements, such as tilt and pan, to allow maximum freedom on the viewers' part. Or, to use multiple intelligent sensors to strengthen the zooming function. In other words, to emphasize on viewing freedom by heightening system interactivity, and focusing on personal point of views, to find new interactive storytelling techniques.

The association of system and contents of "Tri-Story" is inseparable. System and contents advancement should be considered together, not separately. Their feedbacks to each other are also important factors to improve our proposal.

Finally, not only motion pictures, but contents of the theater plays can also be used. We are interested in users' response to re-innovated motion pictures with a maximum extend of dramatic impression.

5. Conclusion

This paper proposes a concept to the next step to interactive cinema – intuitive cinema. Intuitive cinema keeps the essence of cinema, and allows viewers full freedom in subjective watching, by taking users' motifs, the quality of immersion, and users' personal point of views into consideration. Basing our concept on the approaches mentioned above, we developed a new interactive storytelling technique that uses the physical actions provided by the use of multiple screens – the core system and content development of "Tri-Story".

In the future, movies will be increasingly personalized. We hope and anticipate that our contribution of the concept of intuitive cinema will effect the future of film developments.

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