Enhanced Entertaining Experience For Creative LBE with atMOS System

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Abstract. This research proposes "Creative LBE (Location Based Entertainment)" which adds self-expressivity to existing participation and experience-based LBE, and also the new experience that can be obtained in this process. As an approach to Creative LBE, we developed "atMOS" system in which the users can experience "Self-Expression Entertainment" based on physical-action. In atMOS, users can do Sound and Image processing based on a performance and make an original promotion movie (Self-Packaging Movie) which makes oneself a material for a movie. atMOS is a new entertainment content which produces the new experience by expanding expressivity of interactive art based on live performance and entertainment characteristic that LBE originally has.

Keywords. LBE, Performance, Entertainment, Experience Design, Interactive Systems, Real-Time Processing, Visualization, Sound-Image Relationships, Max/MSP

1. Introduction

Due to the development of digital technology, the entertainment contents in which users can do the full-dress virtual experience have been enriched. The representative entertainment is the Location Based Entertainment, which creates "a place" of virtuality. LBE that needs large-scale systems are already things of the past. Now, contents in which users can experience a place of virtuality overflow in various places such as game centers. Most of them have adopted physical control. Some of them have also added self-expressivity by performance, sound and image. However, they are lacking in self –expressivity as game characteristic was considered as the most important factor.

This research proposes "Creative LBE" as an active digital entertainment content, which adds self-expressivity to existing LBE, and the new experience. As its approach, we developed atMOS system so that users can experience "Self-Expression Entertainment" based on physical –action. In atMOS, we adopted the approach of interactive art based on live performance in order to add self-expressivity to existing LBE. The release of Max/MSP and Jitter by Cycling'74 was a big turning point to interactive art and many contents were born. These contents take various approaches in the process of sensing of body motion and mapping of its information. But they have several problems respectively. We developed atMOS system, by supposing that we can expand to its self-expressivity by solving the problematical point in the existing interactive art based on live performance, and that we can produce the new experience by adopting simple operativity and entertainment characteristic that LBE originally has. In atMOS system for Creative LBE which we propose, users can do sound and image processing based on the digitalized data of the user's motive action and produce and make an original promotion movie (Self-Packaging Movie) which makes oneself a material for a movie.

Below, in the second chapter, we mention the present condition of interactive art based on live performance and the present condition of LBE as a background of our research. In the third chapter, we mention the concept of atMOS as a Creative LBE, and in the forth chapter we mention its implementation. In the fifth chapter, we evaluate and consider about this proposal and lastly we mention the summary and the future view.

2. Background

2.1. Location Based Entertainment

Location Based Entertainment (LBE) is highly immersive and audience experience-based entertainment which derived from High Density technology, Virtual Reality (VR) technology and Mixed Reality (MR) technology due to the development of these technologies [1]. Originally LBE started with an enormous screen [2] which the audience obtained the high immersion impression such as IMAX. It developed as an experience-based content where the audience became the character in the story such as Disney Quest in Chicago [3]. It is difficult to say that many of these contents are entertainment that the audience can repeatedly enjoy many times. This is because the stories are planned from viewpoint of the entertainment mainly based on virtual experience and the interface is simplified in order for everyone to be able to participate regardless of the age. Furthermore, these contents need a large-scale system and holds problems from the aspect of cost and space.

Apart from the LBE that needs this kind of large-scale system, there are many cases where various LBE contents are offered in a relatively small-scale space, such as game centers. We list a several of these cases.

For example, “Ollyking” by SEGA [4] is a skateboard bodily sensation simulation game. A user rides on the controller designed to the shape of the skateboard and advances the game. Adjusting to the play of the user, various effects of graffiti pitch are displayed in real time. In addition, "SoulSurfer" by SEGA [5] is a surfing bodily sensation simulation game. The user rides on the controller designed to the shape of the surfboard and glides the course which changes the form and shape and attacks.

Although these are based on the immersive impression, problems of cost and the space seen in the large-space system are cancelled. In addition, by not making use of the usual control pad, consisting of the button and the joystick, but by adopting a way of control based on physical action of the user, the interface is simplified in order for everyone to be able to participate. Furthermore, there are some entertainment contents that have adopted the physical control and also added live performance and self-expressivity in a small-scale LBE.

For example, “BeatMania” by KONAMI [6] is a DJ bodily sensation simulation game. Adjusting to the musical accompaniment and timing and by operating seven keyboards and turntables, the user can generate music. In "BeatMania", the user can obtain the experience to be a DJ. But, the user follows the rules of sound timing, so it is not possible to implement the positive self-expressivity of the user from the viewpoint of expressivity of the content. In addition, “Dance Dance Revolution (DDR)” by KONAMI [7] is the dance bodily sensation simulation game. Adjusting to the musical accompaniment and timing and by operating 4 buttons installed on the bottom of the frame with steps, the user can generate music. By thinking of how to move the foot, the user can enjoy its own sufficient dance performance. But, the content is lacking in self-expressivity because the game characteristic was considered to be the most important factor, similar to "BEATMANIA".

“EyeToy”, developed by Sony Computer Entertainment [8], adopts physical control in the game contents for home use. Its experience resembles the experience that our research proposes in the point of application, which shows body feeling to the virtual space utilizing background subtraction. But, it is difficult to say that it seriously considers not the game characteristic but the self-expressivity.

In some contents listed here, the user can enjoy image and music as an effect based on physical control. It is a feature that the audience around are intensive not to the image and sound which the user plays but to the performance itself which is the physical action and the controller. On the one hand, the user enjoys not only the immersion impression of the game itself but also the performance itself. Generally, the user and the audience enjoy the performance itself compared to the result content such as image and sound.

This way, as for the present condition of LBE, the small-scale system and physical action are the main current. The current problem is summarized in the point that an entertainment content which has self-expressivity, in which the user and the audience can enjoy not only performance but also sound and image as a result of the content, and overflows in creativity does not exist.

2.2. Interactive Art with Live Performance

We refer the existing interactive art based on live performance as an approach adding self-expressivity by physical action in the Creative LBE which we propose in our research. In interactive art based on live performance, the performance of the user is measured, and various signal processing is done vis-à-vis that signal. And as the control signal, sound, illumination, image and in addition each media of the actuator are changed. The process is roughly classified to the process of Sensing which measures the performance of the user and the process of Feedback which allocates the measured value to various parameters and presents the content to the user. And, in the respective process, various approaches were taken so far. We list several cases of interactive art based on live performance.

"S3GA mark2" by Portable[k]ommunity [9] is the physical action installation in which the user plays with the 3D mouse in the weapon. The program reacts to the users' output image and sound. Although it has simple interface utilizing the 3D mouse and physical action, the relativity of interaction between the action of the user and the actual content of the processing is indistinct.

"Messa di Voce" by Golan Levin and others [10] is the system which interactively visualizes the voice of the performer on the basis of the information of position of the performer. The high-level interaction of performance, image and sound is implemented with a simple system. But, self-expressivity of the user in this system is reflected only the information of position and audio level.

"Body Brush" by Hay Young [11] converts the information of position which is traced by blob tracking to the 3D image and sound. In the drawing mode, the line is displayed, which shows the run pattern of the user in the projector installed in the wall, and the color tone and form of the image change with the speed, the pace and the acceleration which you walk. In the musical performance mode, the musical interval becomes high when the hand is lifted, and volume rises when the arm is expanded. Although "Body Brush" implements high-level reproducibility of the position and the speed of the user in the drawing system, we can point out the non-clearness in the connection of the movement in regard to the algorithm of color-tone change and form change. Furthermore, the drawing mode and the musical performance mode are the independent contents, so concurrent processing is not done and the relativity is not recognized.

"ScannedV" by Cristian Ziegler [12] reflects body movement of the dancer in the abstracted form as a texture of the object of the image on background. We can recognize the relativity between the movement of the dancer and the image on background. But, the target of sensing is the movement of the entire dancer, so the quantity of the movement of the dancer such as speed is not reflected on processing. Therefore, the reproductibility of the movement of the dancer reflected on the content of processing is insufficient.

"Iamascope" by Sidney Fels [13] is the interactive dance musical instrument which uses the image entry interface utilizing the dance of the user. In this system, melody is generated by image processing of the simple movement of the user and the judgment whether sound is put out or the area where the image is split. In "Iamascope", the movement of the user is naturally reflected on image because the user itself becomes the material of the kaleidoscope image. But, it is not the case that generation method of the kaleidoscope continues to change interactively according to the way of movement or the quantity of the movement of the user. And, in regard to sound, body operation itself of the user is not reproduced because the sound is generated on the basis of the change of brightness which occur with operation of the body in front of the camera.

Here, when we summarize the point of problem in the existing interactive art based on live performance, the problem is in the process of Sensing and in the process of Feedback. Concerning the former, a large-scale system becomes necessary if high-level reproducibility of body movement of the user is necessary. Concerning the latter, the relativity between body feeling of the user and the contents of processing (sound and image processing) is weak, and a mental model of the user is not considered.

We aim to expand the experience in the existing interactive art based on live performance by canceling problem of Sensing and Feedback in the Creative LBE, which we propose in our research.

3. Proposal

Here, summarizing the description above, the experience in atMOS as the Creative LBE, which we propose in this paper, should give the feature below from the viewpoint of self-expressivity of interactive art based on live performance and entertainment characteristic that LBE originally has.

(1) High-level reproductibility of the movement of the user by a simple input equipment (2) Relativity between each element in operating sound and image with performance
(3) Operativity in order for everyone to enjoy simply
(4) Entertainment characteristic that LBE originally has

In (1) and (2), we refer to the partition of Sensing and Feedback for interactive art based on live performance, from the viewpoint of self-expressivity that is the feature characteristic of Creative LBE.

In addition, we list (3) and (4) as the basic element of LBE. For (4), it originates that Creative LBE is certainly an entertainment content and a different specification from interactive art is required. Namely, atMOS as a Creative LBE is not only a system for self-expression but also a system which is conscious of the entertaining target, though the main function of existing interactive art based on live performance is the manifestation of self-expression. In atMOS, we classify the entertaining target to 2 sorts. First, it is the user itself. We should design the system so that the user can enjoy the process of self-expression based on physical action, that is to say, the performance and the content itself generated to real-time by the performance. Second, it is the audience around atMOS. In LBE, the element, which entertains the audience around in spite of the scale, is included. It is important not to tire the audience around, and to adopt some mechanism in order to attract them to the content and to make them think that they would like to try experiencing the content. Especially in atMOS, we should design the system in order for the audience to enjoy the performance of the user and the content itself generated to real-time by the performance.

Considering points above, we designed the atMOS system in which the users can experience self-expression entertainment based on physical-action as Creative LBE.

4. atMOS

atMOS is the system, we developed, in which the users can experience self-expression entertainment based on physical-action as an approach to Creative LBE(Fig.1, Fig.2). In atMOS, the users can process sound and image, based on the digitalized data of the user's motive action. This enables to produce and make an original promotion movie (Self-Packaging Movie) with oneself as a material for the movie.

In this chapter, we mention "Self-Packaging Movie" as a sub-concept and as the implementation of atMOS.

Fig1. atMOS Photo

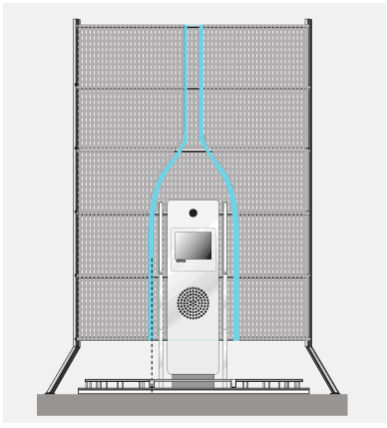

Fig2. atMOS Design

Fig3. Self Package Movie sample

4.1. Self-Packaging Movie

atMOS uses a sensing system to sense the motive actions of the user. Sound and image processing is done based on the digitalized data of the user's motive action. To process images, the image of the user, taken by the embedded digital video camera inside the chassis, is used as the main material. Users can download the result movie into their cellular phones. By saving the movie in their cellular phones, users can enjoy it not only by themselves but also by exchanging them with their friends. In terms of making sound and image processing based on the movement of oneself, and making oneself a material for a movie; it is packaging oneself as content. Therefore, it is a "Self-Packaging Movie". The sample of a Self-Packaging Movie is shown in Fig.3.

4.2. Implement

The system flow of atMOS is shown in Figure 4. It can be broadly categorized into 3 sections, as below.
(a) Performance Section
(b) Real-Time Effect Section
(c) Rendering Section
Sensing of the users' performance is done in (a), and the datais digitalized and sent to (b). (b) allocates the data to the image and sound effects, and sends it to the monitor, speakers and (c) after processing. (c) gathers the movie data and encodes it to a format that can be viewed on cellular phones, uploads the encoded movie to the server, and sends to the user a mail showing the URL to download this movie.

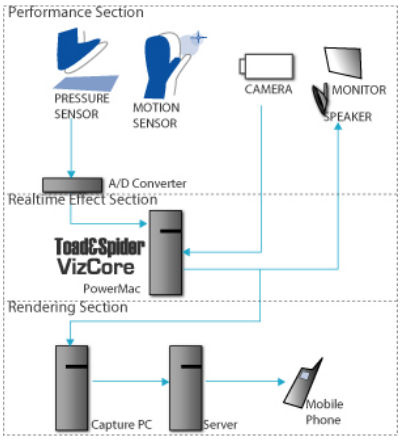

Fig4. atMOS System Flow

In this paragraph, we mention the implemental technique of these sections from the viewpoint of Sensing of the user's performance and Feedback which allocates the data and presents to the user. Among which we mention the concrete implementation of our proposal (1)~(4). As for the development, Max/MSP and Jitter by Cycling'74 was used.

4.2.1. Sensing

Here, we especially mention the implementation of proposal (1). Concretely, we mention how to implement the simple input equipment and how to reproduce user's motive action with it in atMOS. It is the essential condition to satisfy the proposal (3), the operativity in order for everyone to enjoy simply, to adopt the simple input equipment.
atMOS uses a digital video camera and a detection and trace program of pigment to sense the body movements of the user (Fig.5). The target captured by the detection and trace program of the pigment is the ring type LED pointer (Fig.6). As a general rule, there is hardly any load to install and to obstruct user's body movement although the user installs the pointer in the finger. Reduction of the installing load is prerequisite in order to enjoy the performance itself.

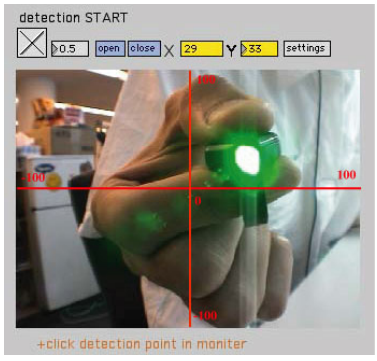

Fig5. Tracking Image

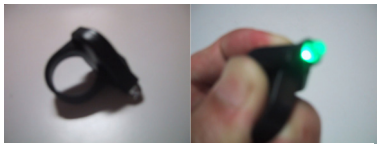

Fig6. LED Pointer

There are three merits to adopt LED pointer in atMOS. Firstly, it is the affordance. By installing the emitter which almost doesn't have any installing load, the user is to urged to move, compared to the state of install nothing. Furthermore, it is possible to give the image, drawing and playing sounds with the brush of light, compared to dancing freely. Users are urged to move naturally, and induced to enjoy performance with the metaphor, drawing and playing sound with brush of light. Namely, the interface is simpler than dancing, and easier for the user to use, and it also induces the user to move. Secondly, it is the production. In atMOS, the image of the user's performance, taken by the embedded digital video camera inside the chassis, is used as the main material. Because of there is a constraint that it is inside the chassis, the color converts entirely homogeneously. Therefore, atMOS intentionally compensates the effect of production considering the productive aspect of the image completed as a result. Furthermore, three interactivities are implemented with a LED pointer, (1) Hue changes of image material itself, (2) Trace of light, (3) Images' effect, responds to the quantity of the movement, when the interaction in the productive aspect of the image is focused. Thirdly, it is thedetection. LED pointer is easy to detect in order to emit the fixed light to all directions. If the movement of the user's hand is traced, there is also a technique which configurates the user's hand as apex and uses both the detection and trace program. But, in this case the problem of error handling and resetting is troublesome after the traced apex frames out and the processing becomes heavy. With LED pointers the problem of resetting the detection and trace point is cancelled, and atMOS relatively obtains the accurate information of position with the fixed light to all directions. And more, it is possible to track without modifying the detection point again if the color of the LED pointer is modified, because the detection and trace program emphasizes not the hue of LED but the information of brightness given out from LED.

Next, we mention the algorithm to detect the quantity of the movement of user's arm with a digital video camera and the detection and trace program of pigment (Fig.7). In the chassis, the monitor is embedded to play intuitively while verifying the result of processing in real-time. Projecting the result of processing in real-time, users can play while enjoying performance and the result content because a user can verify what kind of result is born by the user's performance. A digital video camera is installed on the top of this monitor. The movie, taken by the digital camera, is processed into a reversal image and screened on the monitor. The position of LED pointer, which the user has, is recognized as coordinates (x,y) in XY plane (however, -100<x<100, -100<y<100) in which the central point of this monitor is set to (0,0). The quantity of the movement is detected from subtraction between the present point (x1, y1) of LED pointer and the point (x0,y0), which is the point before 1 phase (200msec) at the sampling period, in this virtual absolute coordinate. And, this quantity of the movement is reflected on sound and image processing. The sampling period is 400msec as one unit, detects the quantity of the movement with the first half 200msec, and applies the value to each parameter at the latter half 200msec. The looping of detection and application is continually repeated because the latter half overlaps the first half of the next sampling period. Thus, the gearing impression between performance and processing is raised. In addition, when the LED pointer of two or more is used, an even XY is returned and the quantity of the movement is calculated with the value. Thus, not only a calculation of multiple LED pointers but also a play at a multiple number of people is implemented, so entertainment characteristic is raised

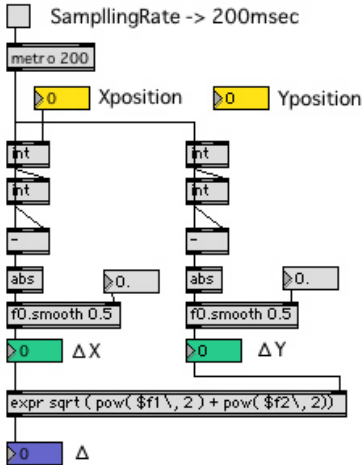

Fig7. Motion-Delta Patch

Furthermore, the foot switches, which consists of eight pressure sensors and measures the on/off information for a load above 2kg, are installed on the bottom of atMOS (Fig.8). The measured value is sent to the system as MIDI information through an A/D converter. 8 foot switches are allocated respectively independent sound and image effect, and the processing which corresponds to the place is done only while user is stepping on a foot switch.

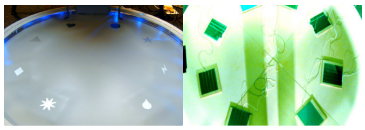
Fig8. Foot Switch

In this case, when the foot switches of two or more is simultaneously turned on, concurrent processing is done, and users can obtain more heavy and more complicated result of processing. Each sensor has a different shaped sticker, so that the user can remember which place to step on when the wants to use the effect. These are the specification in order to achieve the proposal (3), operativity in order for everyone to enjoy simply.

4.2.2. Feedback

Here, we especially mention the implementation of proposal (2). Concretely, we mention how to allocate the data, which is the formed information of user's movement in Sensing, and how to present to the user, and mention the implementation of sound and image processing and the relativity among elements.

As for image processing, the image processing subsystem called "VizCore", does. In atMOS, the image of the user, taken by the embedded digital video camera inside the chassis, is used as the main material and the real-time processing is done to this image.8 foot switches, embedded on the bottom in the chassis, are allocated respectively independent image effect (Fig.9). The strength of effect is linked with the quantity of the movement calculated from a subtraction between the present point (x1, y1) of LED pointer and the point (x0,y0), which is the point before 1 phase (200msec) at the sampling period. Namely, the calculated movement of the user is extreme, and also the strength of an effect increases. Thus, the relativity between user's performance and the result content convert clearly, so that proposal (3), operativity in order for everyone to enjoy simply, and proposal (4), entertainment characteristic which the process of self-expression itself has, are improved.

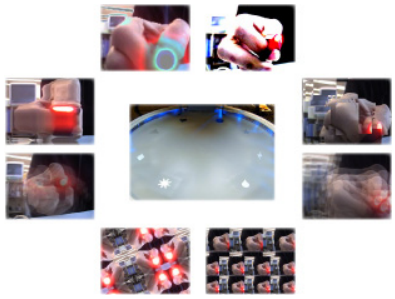

Fig9. Effect Sample

The 8 movie effects have a common meaning for each row. The front row sensors are effects to change the hue of colors. The sensors in the second row are those to process multiplication effects. This can be identified clearly on the monitor while the user is playing at a short distance from the monitor. The sensors in the third row are effects with afterimages. The user can enjoy playing by viewing the monitor from the rear of the chassis. The sensors in the fourth row are effects to change the movie by dividing it into a number of pieces. The user stands at the rear end of the chassis and will be able to enjoy the shapely change of image in the monitor. We explain two samples of image processing, as below.

"Hallucinogen" gives the kaleidoscope effect. The quantity of the movement is allocated to "rotation" and "scale", so that the result of processing is like the kaleidoscope (Fig.10).

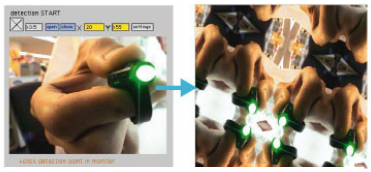

Fig10. Hallucinogen

"JOJO" delimits the image in the small cell like the puzzle, and remaps the cell. The quantity of the movement is allocated to "the quantity of the change of the cell's position" and "the speed of the change of the cell's position", so that the result of the process is like the jigsaw puzzle (Fig.11).

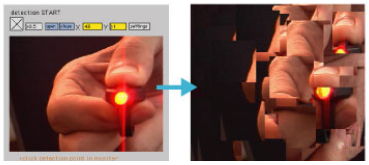

Fig11. JOJO

As for sound processing, the sound processing subsystem is called "Toad&Spider" This system is an automatic music creating engine which automatically processes score creation, real-time synthesis and real-time effects. This tries to automatically complete all the process needed to compose trance/techno music. Toad&Spider is starts simultaneously with the initialization of atMOS and creates a different music each time. Corresponding to real-time input, users can interactively control score creation, real-time synthesis and real-time effects.

Toad&spider generates music using the Stochastic Markov model. The Stochastic Markov is the technique which controls random fraction with the Markov Chain. The engine can always pre-read the state ahead the one step by using the Markov chain, so that t is possible to calculate backward present time from the future.

Considering the completeness of the musical piece, the interactivity was designed simple and to the minimum. For example, it does not randomize the configuration in order for the user to be able to remember configuration. In addition, it makes most of the generation parameter as the fixed value inside. It is possible to change performance of Toad&Spider considerably by changing these values, which needs certain music knowledge, so they are locked with the latest version. It is multiple interactive musical instruments for user to operate. We explain two samples of musical instruments, as below.

With "Teebee303", the user can control the musical interval of the thick base line.

With "U-scratch", the user can scratch sound. The user can scratch by moving the hand back and forth in the same way like a record.

Furthermore, from viewpoint of proposal (4), atMOS adopts virtual-audience program with which the cheering sound is given correspond to the movement of the user. More the user intensively moves in the chassis, more the virtual-audience applauds. These achieve the cycle that the user performs more intensively by virtual-audience's rising and the audience around is pulled by the cheering sound.

In atMOS, sound and image effects are allocated to a foot switch, so both relativities are recognized as a problem. And, atMOS adopts the automatic composition system, so trade-off of the degree of completion of music itself and the sound processing based on user's performance is recognized as a problem. As a result of considering above point, atMOS adopts not the technique to allocate the effect which can be applied commonly to sound and image processing as a common sensuous global effect but the technique to play musical instrument with performance. We list the concrete example and explain the relativity which occurs from combination of the musical instrument and the image effect in atMOS. First, we explain the relativity between "Hallucinogen" and "U-scratch". "Hallucinogen" gives the kaleidoscope effect with rotation and scale. On the one hand, with "U-scratch", the user can scratch sound in the same way like a record. Both relativities are "rotation". Next, we explain the relativity between "JOJO" and "Teebee303". "JOJO" delimits the image in the small cell like the puzzle, and remaps the cell. As a visual effect, the change is very extreme. On the one hand, the change for time-line is many in normal condition with "TeeBee303". Both relativities are a "Change for the time-line".

In atMOS, we implemented multiple image effects and multiple musical instruments beforehand, make each binding after selecting the abstracted common element, such as rotation and change for the time-line, and allocate it to a specific foot switch. It is the technique about "Logical Relativity" that atMOS adopts the technique to logically construct both relativity with the abstracted common element between musical instrument and image effect. It is the attempt to offer the new experience which is differs from the past contents which felt the sensuous relativity between sound and image.

In addition, we implement the image effects linked to sound in order to compensate the visual impression of link between image and sound, and to give the harmony impression, as the dynamic and harmony impression are given in case the rhythm or tempo of image and sound synchronizes [14]. Concretely, the hue of the image material changes linked to the change quantity of the musical instrument based on user's performance separately from the selected image effect. This strengthens the impression of links between the movement and the result of processing. Algorithm of hue change differs depending upon each foot switch.

4.2.3. Entertaining Design

As we mention in proposal (4), it is important that the user and the audience can enjoy both the performance and the result content in atMOS. Here, we explain the element of entertainment adopted in atMOS about proposal (4) without descriptions above.

First, as for design about the chassis itself, we adopt the punching material for the side, so that the user can play without caring about the audience around. On the other hand, it is not a complete blocked space, so the user can attract the attention of the audience around with good allowance. This allows not only the user to enjoy the process of self-expression but also the audience around to enjoy the user's performance.

In addition, we install a monitor outside the chassis, which the same image is projected as the monitor inside the chassis. This allows the audience to share the experience of the user in the chassis. This aims to attract the audience monitoring outside the chassis, and awakens their interest, and induce to actually play next time. Furthermore, the experience in atMOS is not limited to that place, for it can be exchanged with others as the created movie. This aims that the user will experience itself again by watching the movie, so the user will be induced to play again. At the same time, this aims that the user shows the movie to others and the others will be induced to play actually

5. Evaluations and Consideration

As a part of evaluation of this system, we exhibited in U.S.A [15] and Japan [16]. Through the two exhibitions, about 500 people played and we had a few conversations with users after playing. In addition, we carried out an experiment and a questionnaire for users at Keio University SFC in order to prove the approach of this research. The participants are 29 men and women, from 19 to 25 years old. The participant had not played with atMOS in advance. Figure12 is a graph from the result of the questionnaire. The questionnaire was answered in 4 levels (Absolutely Yes, Yes, No, Absolutely No).

As for proposal (1), we used the technique for Sensing with a digital video camera and LED pointer in order to lighten the element, which restricted the body movement of the user. And with simple interface, the quantity of the user's movement in XY plane was detected. This allowed the user to enjoy the process of self-expression with nearly free hand. At the same time, this was the effective approach in order to achieve the proposal (3), operativity in order for everyone to enjoy simply.

As for proposal (2), we implemented considering the relativity between the user's movement and the result of processing and between sound processing and image processing. Through the two exhibitions, we got opinions from many users, such as "the linked impression between sound and image felt good," and "the linked impression between the body movement and the result of processing felt good." In addition, these relativities were proved by the result of Q1 and Q2 of the questionnaire. For Q1, the question whether users felt the relativity between the body movement and the result of processing, 24% user answered "Absolutely Yes" and 63% user answered "Yes". For Q2, the question whether users felt the relativity between the sound processing and the image processing, 14% user answered "Absolutely Yes" and 76% user answered "Yes". These verified the effectiveness of our approach.

As for proposal (3), we adopted the implementation of the processing based on the user's physical action and we implemented considering the operativity in order for everyone to enjoy simply by linking the quantity of the movement with the result of the processing. In addition, the operativity was proved by the result of Q3of the questionnaire. For Q3, the question whether users felt satisfied with the operativity, 17% user answered "Absolutely Yes" and 73% user answered "Yes". These also verified the effectiveness of our approach.

As for proposal (4), it is a subject that not only the user but also the audience can enjoy the process of self-expression. At the exhibition in U.S.A, we could see the phenomenon that the people gathered the monitor outside the chassis and the user performed more intensively. There was the live impression, which was born from the identification between the user and the audience. Furthermore, at the exhibition in U.S.A, we had the popularity that some people visited in the atMOS booth almost everyday. These verified the effectiveness of atMOS's entertainment characteristic not only for the user as a self-expression person but also for the audience.

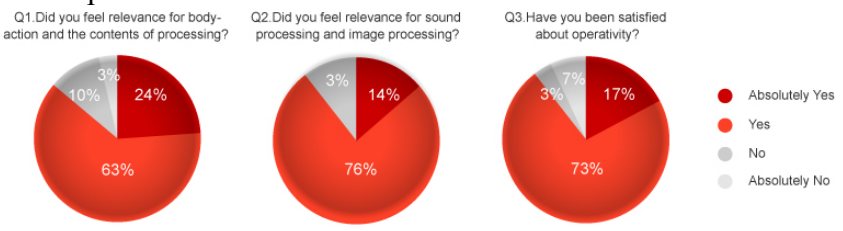

Fig12. Experiment Result @ KEIO University

All these verify that atMOS is the new entertainment content which produces the new experience expanding the self-expressivity of interactive art based on live performance and the entertainment characteristic which LBE originally has.

6. Conclusion

This research proposed “Creative LBE” which adds self-expressivity to existing participation and experience-based LBE, and the new experience obtained from there. As an approach to Creative LBE, we developed “atMOS” system, in which the users can experience “Self-Expression Entertainment” based on physical action. The atMOS as Creative LBE is the system not only for the user to be able to enjoy various self-expressions with simple operativity but also to be able to produce the experience with overflowed entertainment characteristic for the user and the audience.

We mention the future development, as below.

As for proposal (1), the latest system implemented the reappearance of the quantity of the movement in the XY plane, so we would keep tacking the reappearance of the movement in 3 dimensional space in the future.

As for proposal (2), the latest system implemented the relativity between the body movement and the result of the processing, and the relativity between the sound processing and the image processing, so we can give the relativity among the body movement, the sound and the image mutually after achieving the reappearance of the movement in 3 dimensional space and to keep improving mental model in the future.

As for proposal (3), we will develop the system so that the user would like to play skillfully still implementing the element that everyone can enjoy simply. Namely, we keep on improving the self-expressivity as a game by taking in tricks or combinations.

As for proposal (4), we take in the collaborative function of the user and the audiences while having the audience enjoy the production of raising the entertainment characteristic only of that place by focusing on “the place” as the basis of LBE.

We predict that we will create the new entertainment and inspiration by taking in these assignments and creating the new system of Creative LBE and the experience obtained there.

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