rhythmism：
A VJ Performance System with Maracas based Devices

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ABSTRACT
We propose a nonconventional VJ performance system *rhythmism* which uses an original maraca based device that has 2 different functions, material maraca and effect maraca. Rhythmism uses the structure characteristic and the operating characteristics of maracas and adopts the interface to ensure the freedom of the user's physical movement and to realize the powerful attraction of the performance itself and aims to attain the multi-functionality and the arbitrary controllability. In this paper, we introduce the advantages and the interaction techniques of the maracas based device when used for VJ performances.

Categories and Subject Descriptors
H.5.2 [**User Interfaces**]: interaction styles, input devices and strategies

J.5: [**Arts and Humanities**]: performing arts

General Terms
Performance, Design, Human Factors

Keywords
VJ, Performance, Physical Computing, Entertainment Computing, Maraca, Shaker, Interaction technique

1. INTRODUCTION
The concept of tangible bits [1] was revolutionary in the field of computing. After the appearance of Tangible Bits, many attempts were made to recover the physical sense in HCI. This trend is also prominent in the Entertainment Computing field. There are many researches on live performances realized by tangible computing and physical computing in this trend. There are 2 types of directions for these researches, the function focused model and the performance focused model and they both have its advantages and disadvantages. First, the function focused model realizes specific tasks such as improvisation, DJ (Disk Jockey) and VJ (Visual Jockey) by using tangible/physical computing and aims to realize the DJ system and the VJ system as hardware or to realize those functions as desktop applicationalized software given its embodiment. Although these function focused models have multi-functions and arbitrary controllability, they lack the appeal of performance itself as the freedom of physical movements is limited, commonly seen in tabletop systems. On the other hand, performance focused models attempts to create a sound or a visual effect by sensing the physical movement in real time. It ensures the freedom of physical movements and appeals its performance well, but the function is simple and the controllable area is small.

In response to this, we propose a new VJ performance system *rhythmism* which retains the advantages of the 2 earlier research models. That is to say, this system has multi-function and arbitrary controllability as seen in the function focused model and it also ensures the freedom of physical movement and highly appeals the performance itself as seen in the performance focused model. Rhythmism realizes these features by using 2 original maracas based devices (material maraca/ effect maraca). Each maraca based device is embedded with a RFID aerial, XY acceleration sensor and an original rotation sensor, and has an opening at the top point of the device. Material maraca can load the arbitrary motion graphic data by inserting the ID tag embedded material ball on the opening of the device. The playing speed of the motion graphic data changes relatively depending on the amount of movement by the maracas on flatland detected by the XY acceleration sensor. Also, this maraca can read out the motion graphic data one by one in ID order from the loaded motion graphic data by the original rotation sensor which detects the rotation movement of the maracas. As for the effect maraca, it can load the arbitrary effect data by inserting the ID embedded effect ball on the opening of the device. The specified parameter of each of the effect data changes relatively depending on the amount of movement by the maracas on flatland detected by the XY acceleration sensor. Also, this maraca can read out the effect data one by one in ID order from the loaded effect data by the original rotation sensor which detects the rotation movement of the maracas.

There are 2 advantages, in terms of usability and affordance, for using maracas based device to switch the motion graphic data and the effect data and to obtain each parameter. The first advantage is the structure characteristic of the maracas. Maracas, as an instrument, can create one's favorite sound by inserting all sorts of objects inside. Based on this structural characteristic, it enables people to easily recognize the rule that the player can play one's favorite motion graphic data and effects by placing the arbitrary ball shaped object as the motion graphic data and effect data on the maracas based device. The second advantage is the controllability of maracas. As everyone understands how to use it, like shaking and turning, from experience it ensures the usability as an interface. Moreover, the inseparability of maracas and Latin music recalls the memory of excitement. Rhythmism realizes a new VJ performance system that holds the advantages of each of the 2 earlier researches by effectively applying these 2 characteristics to the interaction.

In the next chapter, the earlier researches for the function focused model and the performance focused model are being mentioned. Also, we state the earlier researches for maracas type or shaker type device. In the third chapter, we explain the system and hardware of rhythmism and in the fourth chapter, we explain the interaction techniques. Finally, we state the discussions and conclusions of each feature in the fifth chapter.

2. RELATED WORKS

2.1 Function focused model

There were earlier researches focused on the function and the controllability of its live performance by using tangible/physical computing. For example, there are researches that enable a task in playing an improvisation, DJ (Disk Jockey) and VJ (Visual Jockey) as a performer, using tangible/physical computing.

As for the expansion of DJ play, there are researches such as Mixxx by Anderson [2], D'Groove by Beamish [3] and Lupa by Lippit [4]. Mixxx controls the software through MIDI protocol using a mixer type device and a turn table to visualize the played sound using OpenGL. It also searches and synchronizes the sound file by using an analog turn table. D'Groove aims to support the transition from vinyl to digital media for DJs by implementing turntable type interface using a Force feedback system and a slider device for jumping access reflecting the image of needles on the turntable. Lupa is a custom hardware/software tool set for turn table musicians to capture, layer and control the sound created in the live performance.

For desktop sound creating system, Audio Pad by James Patten [5] and reacTable by Sergi Jorda [6] are earlier researches. Audio Pad tracks the location of the object placed on the tabletop interface and applies that movement as a command to the loop based musical synthesizer. reacTable analyzes the posture and the location of the object placed on the surface of a transparent round table and uses it as a parameter for modular sound synthesis. Also, there are earlier researches such as Pin&Play&Perform by Nicolas Villar [7] which implements an arbitrary physical controller.

These earlier researches attempts to expand the user's experience on the DJ/VJ system as a hardware by computation or to give a concept of physical/tangible to a desktop applicationalized software [8][9] which has those functions. However, the physical movement in these cases is limited to tabletop operations, close to desktop operations, and has a problem that there is less physical freedom. Futhermore, there also is a problem that the appeal of performance becomes difficult as the movement is limited to a specific physical part and the posture is limited to the user facing down.

2.2 Performance focused model

Meanwhile, in the live performance system which introduced the tangible/physical computing, there are many researches focused on the performance itself by ensuring the freedom of physical movement. For example, there are researches that extract the performer's physical movements by using a sensor and image processing technology and assign a given parameter for real-time creation in sound performance and visual performance.

Representative examples of sound performance which seeks the freedom of physical movement are BioCosmicStorm-2 by Nagashima [10] and Body Brush by Horace H. S. Ip [11]. BioCosmicStorm-2 enables the creation of sound linked to the physical movement by wearing a MINI BIO MUSE-2 which gets the data from the 16 channel myoelectric sensors ensuring the freedom of physical movement. Body Brush converts the user's location information and the acceleration in 3 dimensional space to 3D images and sound by blob tracking.

Representative examples of visual performance are EffecTV by Fukuchi [12], the case example by Meador [13] and CAPTURE by Toeplitz [14]. EffecTV is a VJ system that uses the background subtraction in image processing and applys a random effect according to the intensity of the subtraction between frames. The case example by Meador and CAPTURE aims a collaboration of dancers and visual images. The former captures the dancer's movements by image analysis using motion capture suits and a camera while the latter uses only image analysis. In these systems, there is a big attractiveness as a performance as the freedom of physical movement is ensured. Although these systems link the effect parameter with the performer's physical movement, the effect switching is not logical to the physical movement. In concrete terms, the effect switching can be done by automation of the timeline, control by a third person or control by the performer himself. As for the control being done by the performer himself, it is rarely seen that the user's dance performance, a natural action in the context, is set in as the control method, as seen in our earlier researches atMOS [15] and MYSQ [16].

These cases for sound performance and visual performance ensure the freedom of physical movements and enable appealing expressions and have a big attraction as a performance. Nonetheless, the function must be kept simple if it is to ensure its freedom and maintain the control at a basic level. At the same time, there is a problem that there is a lack of logic to the physical movement and the function switching. As for controllability, there are many systems that the controllable area for the performer is small or that it is too difficult to control without being trained.

2.3 Maracas based / Shaker based device

There are some earlier researches that adopted maracas base or a shaker base as in rhythmism. PhiSEM by Cook [17], Air Percussion by Havel [18], Digital/Hyper Shaker by Weinberg [19] and Audio Shaker by Hauenstein [20] are some of those examples. PhiSEM can control the ensemble of instruments, such as piano, by shaking some shaker based devices. Air Percussion is a virtual percussion that uses a stick embedded with a 3D position/XYZ acceleration detection system called Flock of Birds. These examples only realize the sound control by focusing on the shaking action of the maracas and the shaker. Digital/Hyper Shaker can not only be used as a controller that changes the value of the acceleration sensor to MIDI, but it can sample the sound of the object in the maracas and control this sound output parameter by the speed of acceleration. As for Audio Shaker, by sampling the sound and shaking the device, the time scale of the sampled sound can be broken down according to the speed of acceleration. This realizes only the sound control by focusing on shaking, the structural feature, the original maracas or shaker. Rhythmism provides a new VJ performance experience by applying the controllability of the maracas and the structural feature of shaking and turning, to its interaction.

3. SYSTEM ARCHITECTURE

Rhythmism's hardware consists of a material maraca which selects the motion graphic data and controls the speed of playing, an effect maraca which selects the visual effect and controls the specific parameter for each effect, a computer (Intel Mac) which has the original VJ software installed and a projector which outputs the created image. Also, each maraca is embedded with a RFID aerial, XY acceleration sensor, an original rotation sensor which consists of an IR sensor and a metal ball, LED and a slide switch (Figure 1). The data from the RFID aerial can be obtained through the RFID module which is connected with RC232 cable to the computer. The data from the IR sensor, slide switch and the LED can be obtained from the Phidget Interface 8/8/8. The data from the XY acceleration sensor can be obtained from the Micro Controller (Basic Stamp 2) connected to the computer with a RC232 cable (Figure 2).

4. INTERACTION TECHNIQUES

Rhythmism is implemented with a interaction technique that uses the control feature of maracas and the structural feature, for example, shaking and turning. Using these features, we realize the multi-functionality and the controllability of function focused models in live performances when implementing the existing tangible/physical computing. Moreover, we realize the big attraction of the performance itself and ensure the freedom of physical movement of the user as in performance focused models.

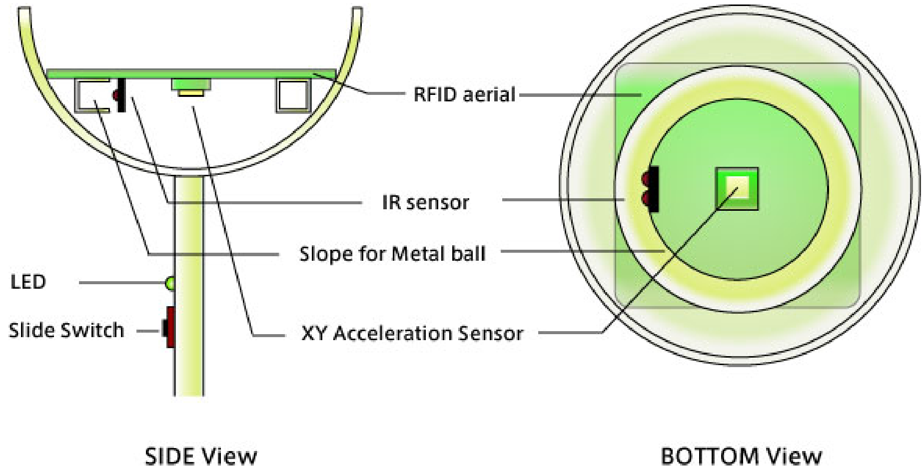

Figure 1. Maracas based device configuration diagram.

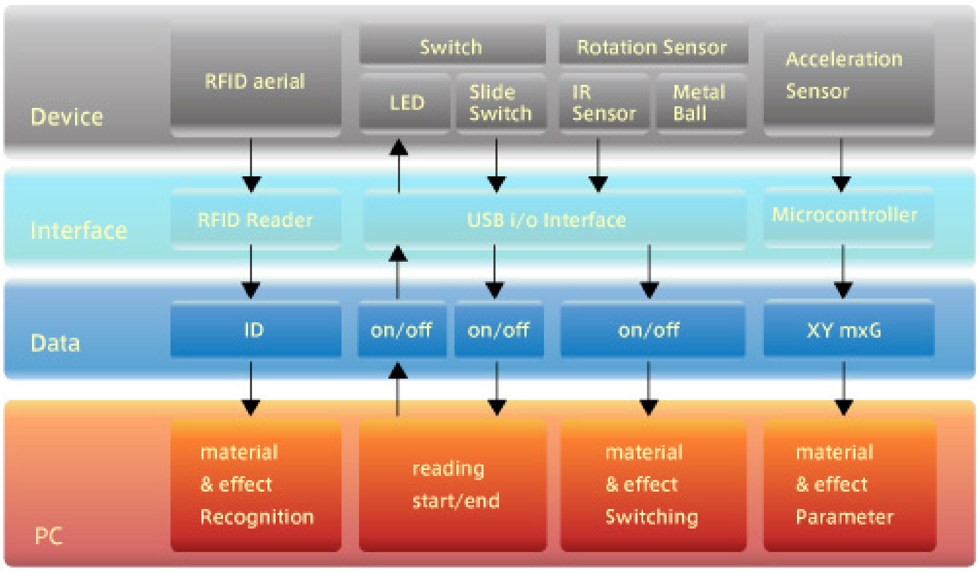

Figure 2. Rhythmism system architechture.

4.1 Interaction techniques based on the structural features

Based on the structural features of the maracas based device used in rhythmism, the motion graphic data and the effect data is loaded to use for the VJ performance. First, the user inserts the ball-shaped object, which has a RFID inlay with an ID each, to the opening at the top of the maracas based device to read the motion graphic data and the effect data that the user uses from the temporary table in the application (Figure 3). The motion graphic data object must be placed on the material maraca and the effect data object must be placed on the effect maraca. After inserting the objects, the application will activate the RFID module and start reading the ID in the RFID inlay embedded in the object through the RFID aerial by sliding the switch on, which is on the side of the device stick (Figure 4). The LED will start blinking when it starts reading the data and will be lighted continuously when the reading is finished. The slide switch is positioned where the user can control the slide switch with one's thumb when holding the device with the thumb parallel to the device. When the reading is over, the ID, existing in the object in each maraca, is stored on the table in the application. The data on the table can be cleared by switching the slide switch off.

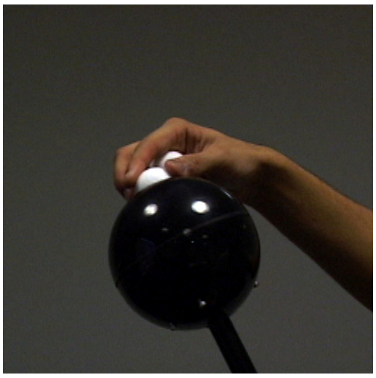

Figure3. STEP1: Insert the RFID inlay embedded object to the maraca.

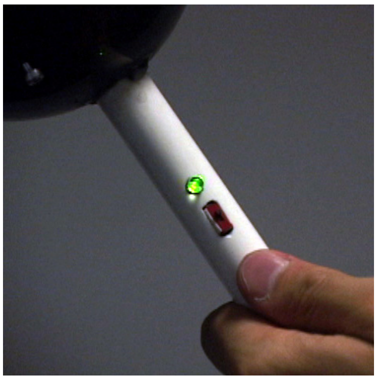

Figure4. STEP2: Object ID can be loaded by switching to on.

4.2 Interaction techniques based on the controllability

4.2.1 Shaking

By the shaking action, one of the controllability features of the maracas based device for rhytmism, we determine the image playing speed and the specific parameter for each effect. An XY acceleration sensor is used to sense the shaking action of the maracas. As shown in Figure 1, the acceleration sensor is fixed at the center of the RFID aerial. The XY acceleration sensor is controlled by the Micro controller and the XY acceleration speed can be obtained every 20msec. Micro controller calculates the vector XY from these data and sends to the application in the computer. Considering the development of noise when accelerating, the value obtained every 200msec is normalized to reduce the unwanted noise of the sensor. According to the result of the operation test, the vector XY for a still maracas is 0mxG and the maximum value when moving is 3000mxG. The value ranging within this range is scaled relatively and converted to a real value of 0 to 100. The value from each maraca is processed individually.

First, the parameter mm (0-100) obtained from the acceleration of the material maraca is used to control the playing speed(ms) of the image. As the parameter mm changes every 200msec, a line imputation is done between the continuous value mm_{n-1} to mm_n to make the change smooth. Parameter ms is relatively scaled according to parameter mm , so it dynamically changes from minimum 1.0(same size) to maximum 3.0(triple).

Next, the parameter em (0-100) obtained from the acceleration of the effect maraca is used to control the specific parameter(ep) of the effect. In the present version, 8 effects are implemented (Table 1). As the parameter em changes every 200msec, a line imputation is done between the continuous value em_{n-1} to em_n to make the change smooth. Parameter ep is applied after it has been relatively scaled according to each effect parameter.

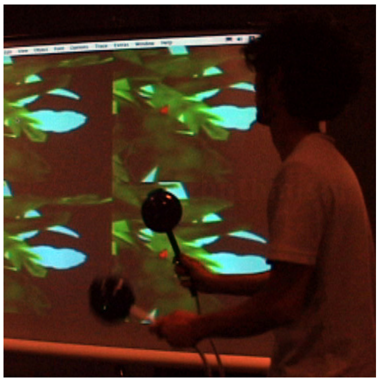

Figure5. STEP3: Control the playing speed of the active motion graphic data by shaking the material maracas and control the specified parameter for the active effect by shaking the effect maracas.

Table 1. ID of each effect, effect name and control level.

ID	Effect name	Description	Control level*
1	Ghost	Effect to realize a feedback by remaining each frame of the image for arbitrary seconds.	Feedback seconds (0.0-2.0)
2	Domino	Effect to realize a screen partition by scaling the image to XY directions at the same rate.	Screen partition number (1-5)
3	BrCo	Effect to realize the tone difference by controlling the brightness and the contrast of the image at the same rate.	Brightness (1.0-6.0) Contrast (1.0-6.0)
4	OffShoot	Effect to realize the image overlapping by dividing the image into 4 layers and moving each layer to 4 directions.	Each layer's movement rate (0-50)
5	Hallucinogen	Effect to realize a kaleidoscope image by controlling the rotation and the contraction of the image to XY direction.	Rotation (0-10) Contraction(1.0-0.1)
6	RGB	Effect to realize a hue difference by controlling one of the values of RGB in an image randomly.	RGB value (0-255)
7	Whiteout	Effect to realize a whiteout by controlling the additive synthesis rate of the white screen in the image.	Screen synthesis rate (0.0-1.0)
8	Blackout	Effect to realize a blackout by controlling the additive synthesis rate of the black screen in the image.	Screen synthesis rate (0.0-1.0)

*the parenthetic part shows the rate of change

4.2.2 Turning

By the turning action, the other one of the controllability features of the maracas based device for rhytmism, we switch the image and each effect used in the VJ performance. An original rotation sensor is used to sense the turning action of the maracas. As shown in Figure 1, an original slope, made by the square extrusion, is fixed on the outside of the RFID aerial in the maracas. This original slope has an opening on the side to place an IR sensor. A metal ball, weighing 5.5g and 11mm in diameter is placed in the slope and this metal ball is detected when passing through the IR sensor. According to the operation test, the threshold number of balls to be put in the slope was 4. When 4 balls are continuously detected passing, then the signal 1 is sent to the application through the USB interface. If no balls were detected, then the signal 0 s sent to the application. The IR sensor is located in alignment with the slide switch and the LED inside the stick. Therefore, when the user is holding maracas at first, the metal ball is placed diagonally from the IR sensor.

The switching of the images and the effects are done according to the value of the rotation sensor when it detects the ball passing and the ID stored on the table in the application. By switching the slide switch on, the ID, from the ball type object in the maracas, is stored in the image group or the effect group on the table in the application through the RFID module (Figure 4). Immediately after the storage is in the default state, so the image and the effect with the smallest number of ID on the table becomes active and is output to the projector. Then the ID will switch in order when a rotation is detected in the rotation sensor. For example, if the ID number of effects stored on the table in the application was 1,4,5,7, when the rotation sensor detects a rotation, it switches in 1,4,5,7,1,4,5,7 order.

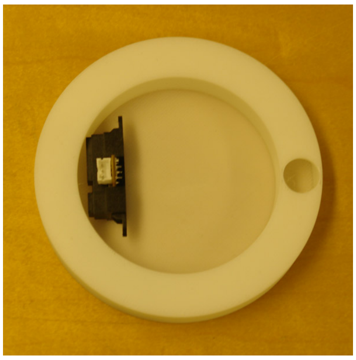

Figure6. Original Rotation sensor form

5. DISCUSSION AND CONCLUSIONS

In this paper, we proposed a new VJ performance system rhythmism using 2 original maracas based devices that each has individual functions. In rhythmism, a maracas based device was used to ensure the freedom of the user's physical movement and to realize the big attraction that the performance itself has, which both are the features of the performance focused model. These features were realized by implementing an interface function to the maracas based device and by emerging the performance using the affordance that the maracas originally have. Moreover, by using the structural features and the control features of the maracas, the multi-functionality and the arbitrary controllability, that the function focused model has, was realized. Theoretically, this is due to the fact that the user can control the specifications of the combination {the combination number of objects in the material maraca (${}_8C_n$) x the acceleration parameter of the material maraca (mm =0-100) x the combination number of objects in the effect maraca (${}_8C_n$) x the acceleration parameter of the effect maraca (em =0-100)}.

However, there are 2 limits to the structural features and the control features. First, as for the structural feature, there is a limit to the number of image objects and effect objects which can be used for one object insert. Each object depends on the size of the RFID tag and the present specification is 30mm diameter. Due to this, maximum of only 5 ball shaped objects can be inserted in the present version. Furthermore, the opening to put the ball shaped object is easy to attach as it can be attached as a slide cap but it distracts the natural performance. Improvement must be made to increase the number of data the user can use when inserting an object once,by using a smaller passive ID tag. Secondly, as for the turning action in the control feature, the data will switch to the next data when the device rotates once, but this depends on the ID order that the ball shaped object has. Improvement must be made so that the user can switch the data in a specific order.

For the future development, we will improve the above 2 limitations and implement the 2 things below. One of the implementation is an additional implementation for the control feature. For example, the maracas as an instrument can create a sound by hitting the maracas together. We bring this control model to the system and add a new expression to the image and the effect. Also, another implementation is the collaboration of multiple users. The realization of collaboration between not only multiple users in the same area but also by users in remote places using network is to be pursed.

6. ACKNOWLEDGMENTS

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