Study on the Needs and Effects of Unifying Interactive Multimedia-based Play Equipment for Children

*Cheon-Hoo Jeon, Young-Ho Kim, Yang-Kyu Lim, and Tak-Hoon Kim**

Graduate School of Advanced Science and Multimedia Chung-Ang University / Seoul, Korea
**Corresponding Author (takhoonkim@naver.com)*

Abstract: Currently, multimedia experience equipment for children's interior entertainment parks faces complex installation processes, high maintenance costs and labor costs. And it is not easy to replace equipment that already has been installed, so the equipment is being used for nearly ten years. To address these problems, the Commission describes the need to reduce costs, install equipment, and replace content in the equipment that is required to implement the equipment, projector, and kinetoscope.

Keywords: Multimedia, Interactive Media, Galaxy Kids, Expense, module

Received Aug. 27, 2017; accepted for publication Sep. 06, 2017; published online Sep. 06, 2017. DOI: 10.15323/techart.2017.08.4.3.22 / ISSN: 2288-9248.

1. Introduction

With the rise of the information age, the trends in space design have rapidly changed. Among them, children's play equipment has shown rapid changes with the inclusion of advanced technology. The display mediums in exhibitions are now incorporating different multimedia technology, which allow the expansion of diversity in space design. The changes in space design have allowed technology to interact more effectively with children. Owing to the rise in the usage of multimedia, children's play equipment has now become a play attraction instead of technological equipment, ultimately attracting new consumers with its new content-related attractions. Especially with the implementation of five days of work regulation in Korea, the number of families visiting exhibitions has increased, and to satisfy the needs of these increased visitors, museums and galleries are now focusing on increasing the number of exhibitions or shows targeted toward children and family visitors [1]. The interactive equipment that encourages interaction between multimedia and its users provides the experience of fun and excitement, which engages children and their interests. The interactive equipment mentioned above allows interaction between technology and its users. It is known as an interactive medium, which is derived from the words "inter" and "active"—"inter," which means "between," and "active," which means "to engage physically," combined together to form the word interactive. Thus, an interactive medium is defined as a medium that allows two or more humans or objects to interact with one another. A user uses an interactive medium to touch and see the interface and interact with the computer, and reach a status of immersion for a stronger sense of interaction through the experience. The interactive medium theorist, Brenda Laurel, defines engagement as an interaction between human and computer in a virtual space. The user is aware that the space is only virtual but accepts this idea [2]. This indicates that children using multimedia media indoors will also be aware that the technology is virtual, but still show high concentration in their playtime through interaction with the equipment.

This study explores the ways to unify a variety of multimedia play equipment as a package to propose a solution to the issues of difficult set-up and high maintenance expenses, and other issues of currently implemented multimedia play equipment. This study suggests measures for cost-cutting and effective ways of implementing indoor interactive multimedia equipment for children and the process to be followed.

Figure 1. Example of interactive multimedia equipment for children

2. Objectives

Previously, incorporation of interactive multimedia equipment for children had many issues to be resolved. First, setting up interactive equipment required a long time—a minimum of one month, and even up to two to three months. Multimedia equipment such as a PC, projectors, and Kinect equipment has to be set up separately, resulting in an increase in the set-up time. As

the set-up time increases, the employment period for each engineer also becomes longer, ultimately increasing the labor costs and the overall cost. Furthermore, the individuality of each piece of equipment is also an issue for long-term use, since each piece of equipment has to be maintained separately, which requires specific labor, thus increasing the labor costs and the overall cost. In order to solve these problems, this study focused on the ways to unify this equipment into a single package to decrease the amount of time required for setting up and effectively cut costs. For the unifying of this equipment into a package, this study proposes prototype hardware and an interactive software using characters from the animation, Galaxy Kids[1]. The following explains the production method of the software.

Figure 2. Example of the project: single package equipment

The interactive multimedia equipment is Floor Mapping[2], which uses a projector for the top-view and hardware integration of Kinect and PC that interacts with its users to create an indoor children's interactive play equipment.

3. Methods

A. Software

The software was created as an indoor interactive media game in the form of a multiplayer defense game. The video image projected by the projector on the floor allows children to participate actively in the game to shield the main character from the bombs thrown by the "evil" character. There are many characters in the animation, Galaxy Kids, but the character Atla[3], the space shuttle, was selected as the main character, and Monkey was selected as the evil character. In the game, the story begins as Atla is transporting some goods to Neptune, but in the process, Atla runs into Monkey, who attempts to intervene with the transportation.

1) Child-friendly Characters

The animation characters used in this study are from the animation Galaxy Kids, which was aired on KBS. Galaxy Kids was chosen since it was aired for a long period, and attracts the curiosity of children with its theme based on space.

Table 1
'Galaxy Kids' Characters

					
Atla	Luna	Zhou	Tunic	Poya	Monkey

2) Design

The characters from Galaxy Kids were designed as actual dolls for stop motion animation, and hence, they were redesigned in 2D to satisfy the requirements of a top-view and game format.


Figure 3. Atla Animation Character (left); flight mode (right)


Figure 4. Status: attacked (left); turning right mode (right)


[1] Galaxy Kids is a stop motion animation created by Taktoon Enterprise. The South Korean animation series aired on KBS: season 1 was aired in 2015, and season 2 was aired in 2016.

[2] Floor Mapping: "Mapping" is a detailed version of a 3D model that includes details such as texture when creating 3D graphic based games. Applying texture is also called texturing.

[3] A character from Galaxy Kids; the character was inspired by a spaceship.

Figure 5. Monkey animation character (left); waiting mode (right)

Figure 6. Monkey attack pose (left); run away pose (right)

Atla has four different poses: a flight mode, left and right turns, and attacked mode. Monkey has three pose designs: wait mode, attack mode, and run away mode. Since the software is targeted toward children, the bomb explosion was designed to be non-violent. The attack motion of Monkey was designed to attack once or twice.

Figure 7. Bomb design (top); blowing up design (bottom)

Since the story is set when Atla is delivering goods to Neptune, the background includes space and other planets that will pass by in the background as playtime progresses. In Image 8, the planets appear closely placed together, but in the actual game, a maximum of two planets can be seen at a time in the game. The game is designed such that the sun and all the planets in the solar system (up to Neptune) make an appearance during the game.

Figure 8. Game Interface

As Image 8 is projected onto the floor, children will interact with the interface to block Monkey's bombs from hitting Atla. The game can be played by a maximum of six players, and it can be incorporated to teach teamwork and enhance motor abilities.

Table 2
Comparison of Kinect V2 and V1

	Kinect V1	Kinect V2
Color image resolution	640×480 (pixel)	1920×1080 (pixel)
Depth image resolution	620×240 (pixel)	512×424 (pixel)
Color image angles	62°×48.6°	84.1°×53.8°
Depth image angles	57.5°×43.5°	70.6°×60°
Number of human figures searchable	2	6
Method of detecting distance	Light coding	Time of Flight
Available distance for depth image	0.8–3.5 m	0.5–8 m

B. Programming

There are two types of Kinect in the market: V1[4] and V2[5]. This study focused on V2 owing to the fact that,

4 Kinect V1's depth sensor reads the pattern of the radiation lights that has been passed through a curve using a technique called 「Light Coding " * 1. Thus, a depth sensor is divided into two: one that penetrates

compared to V1, V2 offers better resolution of the camera, a variety of angles, more detailed information of the distance, and search engine to search body figure, allows up to six players compared to the original two players, and the distance increased from 3.5m to 8m from the floor to the equipment. V2 provides color images and a high-resolution depth image, with a wider field of view. Specifically, the light coding[6] used to gain the depth image was replaced with the time-of-flight method, which allowed fewer errors when extracting distance information [3].

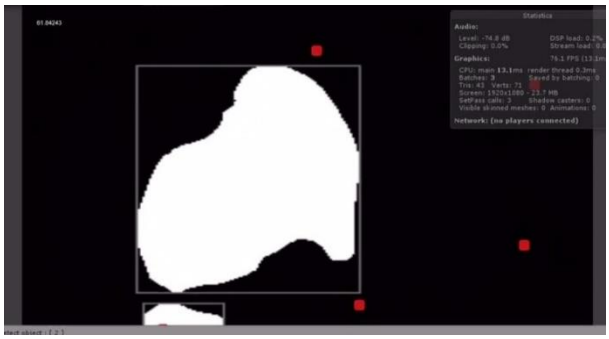

Figure 9. Kinect V2 Motion Detection Test

The white image in Image 9 shows how a human figure is detected in the top-view. The white square outlines show the boundary in which the red object reacts. White square border uses Cinema 4D to design the software with a more detailed touch, and the depth map extraction of Kinect V2 allows the detection of the location of the user; the biological engine of Cinema 4D allows human images to be created within the software, which disappear when the material and red particle touch one another. For future updates and replacement of content, the software was created such that changes can be easily adapted using simple exchange of images, instead of a change in the entire build.

Image 10. Kinect and the program test

Kinect and the frontal projector test used a projector, Kinect, and PC to test the actual operation of the software (Figure 10). After testing the software, the projector and Kinect's angles were closely set and the process of building the hardware began.

4. Packaging of Children's Interactive Media Equipment

The most important aspect in the packaging of children's interactive media equipment is that it should be sufficiently simple to be set-up by anyone. Therefore, the package requires a simple set-up and the basic rectangular shape of a projector was chosen. Inside a wooden box, a wooden panel divides the space such that, starting from the top, a PC, projector, and Kinect are placed in that order. For a PC to fit into the small box, it was divided into parts and placed in the box. Owing to the heating concerns of the three devices, cooling fans were placed at each end for air circulation.

The projector uses a prime lens, and allows focusing from different distances with an external control placed in the front portion of the lens. Kinect and the projector have a very different scope in screen detection, and hence, a PC internally sets Kinect to match the scope of the projector. Owing to the packaging of the media, the equipment has a simple set-up without using any additional technology, as long as a height of 2m or more is guaranteed. If the package runs into errors or the system fails, the package is designed such that it can be fixed similar to any type of PC, i.e., by opening the top and fixing the failed parts separately.

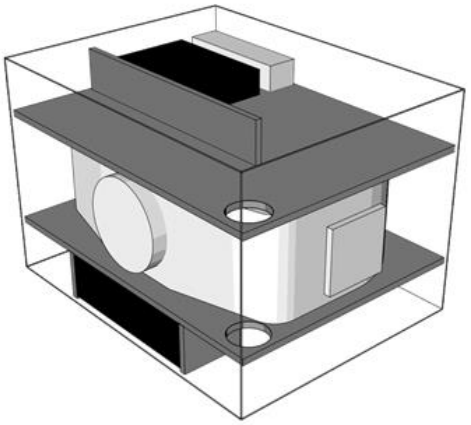

Figure 11. Prototype of the interactive equipment

the radiation pattern (left) and the IR camera that reads the patterns (right). Furthermore, a color camera is placed between the two depth sensors.

5 Kinect V2's depth sensor obtains information about the depth during the time the radiation light penetrates and is reflected back. It uses a method called time-of-flight (TOF) " *2. The depth sensor is not seen externally, but it is placed adjacent to the color camera and the radiation camera (left), and the penetrating projector (right)

6 Also known as structured light; uses stripes or long bar-shaped lights that are reflected off a curve and create a specific pattern. The patterns allow one to analyze the depth of the image.

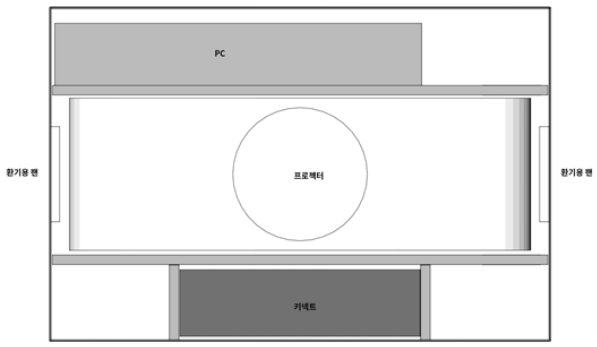

Figure 12. Internal design of the prototype

5. Conclusion

The interactive multimedia equipment market is clearly showing an increase in demand, but the issues of high expenses and maintenance costs remain unsolved. This study focused on the high maintenance fees and set-up costs of interactive multimedia equipment and provided a solution to unify the different equipment into a single package, thus lowering the expenses and simplifying the set-up. Furthermore, by developing new software, a variety of contents can be incorporated.

Since the maximum distance from the installment is 8m, no special technology is required except for a simple set-up. Thus, the costs of setting up and removal of the system are reduced. The prototypes are planned to be set up at the Hong Sheng character theme park, and with an increase in content, it can be expected that the package will allow value creation in both theme parks and kids cafes.

Acknowledgment

This research was supported by Prof. Tak-hoon Kim.

This project was granted a scholarship by the BK21 program (Graduate School of Advanced Science and Multimedia Chung-Ang University).

References

[1] S. Y. Sim and J. M. Moon, "A Study on the characteristics of interaction using digital media in a children`s hands-on program center," *Journal of the Korean Society of Design Culture*, vol. 20, no. 1, pp. 371–381, 2014.

[2] Y. M. Song and H. Yu, "Playing characteristics of interactive media", *Korean Society of Basic Design & Art*, vol. 16, no. 3, 2015.

[3] C. Kim, "Correct Kinect V2 camera and create 3D Point Cloud", Dept. of Electronics and Electrical Engineering, Graduate School Dongguk University 2016 (8).

Biographies

Cheon-hoo Jeon is an M.S. student (2019) at Chung-Ang University Graduate School of Advanced Imaging Science and Multimedia

Young-Ho Kim is a master's candidate at the school of Advanced Imaging Science, Multimedia, and film at Chung-Ang University, South Korea

Yang Kyu Lim is a Ph.D. candidate at the Graduate School of Advanced Imaging Science, Multimedia, and Film at Chung-Ang University, South Korea.

Tak-hoon Kim is Professor at Graduate School of Advanced Imaging Science and Multimedia Chung-Ang University in Seoul, Korea