Support for Museum Exhibition of Small Fungi using AR Technology

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Abstract

There are 25 species of bioluminescent fungi that have been confirmed in Japan, and 12 species have been confirmed in Miyazaki Prefecture. Those fungi are very small. Therefore, it is difficult to observe the structure of fungi exhibited in museums with the naked eye. The purpose of this research is to display 3DCG models of mushrooms using AR (Augmented Reality) technology in order to facilitate observation of these small mushrooms exhibited in museums. Two hundred visitors to the museum were asked to use the application and complete a survey. In order to measure the ease of observation of different app functions and mobile devices used in the survey, we divided the respondents into four groups.

Keywords: AR, Exhibition Support, Museum, bioluminescent fungi

1. Introduction

Augmented reality is a technology that superimposes digital information on the real world. In recent years, AR technology can be used not only on head mount display, but also on mobile devices such as smartphones. This study will examine the use of AR technology to support observation in museums. There are 25 species of bioluminescent fungi that have been confirmed in Japan, and 12 species have been confirmed in Miyazaki Prefecture. Those fungi are very small. Therefore, it is difficult to observe the structure of fungi exhibited in museums with the naked eye. The purpose of this research is to display 3DCG models of fungi using AR (Augmented Reality) technology in order to facilitate observation of these small fungi exhibited in museums.

2. AR Application Development

2.1. Development Environment

An AR application was created for use with smartphones and Tablets. The development environment is shown (Table 1). Blender is a comprehensive 3DCG software. It was used to create a 3DCG model of fungi [3], [4]. Unity was used to develop applications for mobile terminals [1], [2].

Table 1. Development Environment

OS	Windows 10 Pro
Software	Blender 2.93
	Unity 2020.3.22f1
	Visual Studio 2019
Smart phone	Galaxy S8
Tablet	Yoga Tab 11

2.2. Target fungi

The bioluminescent fungi, *Favolaschia peziziformis* [Fig. 1], *Cruentomycena orientalis* [Fig. 2] and *Favolus manipularis* [Fig. 3], were the subjects of this study.

2.3. 3DCG of fungi

The CG model was created based on the images provided.

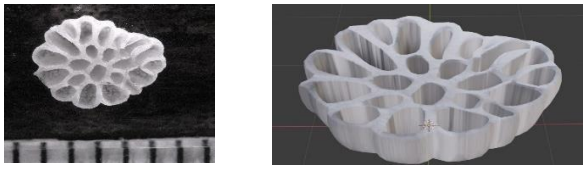

Fig. 1 *Favolaschia peziziformis*


Fig. 2 *Cruentomycena orientalis*


Fig. 3 *Favolus manipularis*

2.4. AR application

An image that serves as a marker is loaded, and an AR 3DCG model of a mushroom is displayed on top of it. When the marker disappears from the screen, the displayed 3DCG model also disappears, and when the same or another marker is scanned, the 3DCG model is displayed again. This application was used as the basic application. In addition to the basic application, another application was prepared with a function that tilts the mushrooms in the same direction when the user moves his/her finger while touching the AR-displayed mushrooms on the screen. A demonstration of the application in use is shown below.

3. Evaluation experiment

3.1. Experimental environment

The evaluation experiment was conducted at the Miyazaki Prefectural Museum. A special exhibition was being held and a place for observation using the application was set up next to the mushroom exhibit. Visitors were asked to cooperate in the evaluation experiment.

3.2. Experimental procedure

The experiment should take no more than 5 minutes. After the observation using the app was over, the participants were asked to fill out a questionnaire. The experiment was divided into four groups using smartphones and tablets, basic apps and apps with additional features. A total of 200 people, 50 in each group, were surveyed. How the experimental procedure is shown.

i. Explain that specimens of glowing mushrooms are on display.
ii. Explain to users how to use the application.
iii. Users use the app to make observations.
iv. Users are free to finish their observations.

Show how the Questionnaire items [Table 2].

Table 2. Questionnaire items

1. Observation was fun.
2. I interested in fungi.
3. New discoveries were made.
4. I understand the structure.
5. It was easy to observe.
6. AR experience was good.
7. Operation was easy.
8. I want to use it in other exhibits.
9. I got the emotion of observing native fungi.
10. I wanted to touch the fungi.
11. Did you notice the hole?
12. Did you notice the rounded bottom?
13. Did you notice the reddish color?
14. Did you notice how the back of the fungus's umbrella is shaped like folds?
15. Did you notice the reticulated underside of the fungus umbrella?

3.3. Questionnaire Results

The questionnaire included questions to answer about the experience of observing the mushrooms using the application and whether or not they noticed any characteristics of the fungi. The questionnaire was based on the MES [5]. Ten questions on a 5-point scale were asked, five questions asking if the mushrooms were observed for their characteristics, and one open-ended question. The results of the questionnaire are shown below [Table 3], [Table 4].

Table 3. Experiences observed using the app (average)

item	Basic apps	Additional apps	Smartphone	Tablet
1	4.9	4.92	4.92	4.9
2	4.57	4.58	4.54	4.61
3	4.72	4.71	4.67	4.76
4	4.51	4.47	4.94	4.48
5	4.76	4.78	4.82	4.72
6	4.91	4.87	4.91	4.88
7	4.75	4.63	4.77	4.61
8	4.8	4.68	4.73	4.74
9	4.44	4.49	4.53	4.4
10	4.45	4.45	4.39	4.51

Table 4. About the characteristics of fungi

item		11	12	13	14	15
Basic apps	Noticed	88 %	68 %	89 %	58 %	66 %
	Didn't notice.	12 %	32 %	11 %	42 %	34 %

Additional apps	Noticed	87 %	82 %	92 %	80 %	85 %
	Didn't notice.	13 %	18 %	8%	20 %	15 %
Smartphone	Noticed	84 %	69 %	85 %	63 %	71 %
	Didn't notice.	16 %	31 %	15 %	37 %	29 %
Tablet	Noticed	91 %	80 %	96 %	75 %	80 %
	Didn't notice.	9%	20 %	4%	25 %	20 %

Since all items were 3 or higher in the experience observed using the app, it can be said that the app is an aid to observation. In comparing the results between the basic app and the app with additional functions, there was a clear difference between Q7 and Q8. The respondents' opinion that simple functions were easier to operate and use was based on the belief that they wanted ease of use rather than in-depth observation. For the question about mushroom characteristics, differences were found at 12, 14, and 15. Apps with additional features for areas that cannot be observed without looking directly at the mushroom from the side, such as the back of the mushroom, were a good result. Comparisons will be made between the use of smartphones and tablets. Differences were found in Q4, 5, 7, 9, and 10. Smartphones can be handled with one hand, making it easier to operate and observe from various angles, which is thought to have led to better understanding of mushrooms. Tablets were found to provide a sense of immersion due to their large screens. In the questions about mushroom characteristics, there was a 10% difference in Q12, 13, and Q14, with tablet users being able to observe mushrooms in more detail.

4. Conclusion

We were able to confirm that AR technology supports observation in museums. The apps with additional functions were found to allow more detailed observation of the mushrooms. As for the difference between the different devices, it was also found that the tablet device allowed for more detailed observation of the mushrooms. However, the basic function apps were better in terms of ease of use, while smartphones were rated higher in terms of ease of observation. Therefore, it is better to use a smartphone when carrying a mobile device for observation when used in a museum. In this way, it is important to use different app functions and mobile devices depending on the situation in which they are used. In this study, we supported the observation of small objects, but in the future we would like to consider supporting the observation of very large objects that are difficult to observe.

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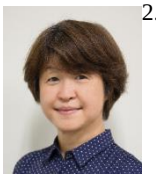

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