Basic Study on Museum Exhibition Support Using AR Technology

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Abstract

There are many bioluminescent fungi in Miyazaki Prefecture. All of these bioluminescent fungi glow in the dark and are attracting attention as a new tourist resource in Miyazaki. However, they are small and not easily observed in museums. The purpose of this study was to facilitate observation of such small mushrooms exhibited in museums by using AR technology to display a 3DCG model of the mushroom body in AR to aid observation.

Keywords: AR, Exhibition Support, Tourism Support.

1. Introduction

Augmented reality is a technology that superimposes digital information on the real world[1]. 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.

2. Research Background

A mushroom exhibition was held at the Miyazaki Prefectural Museum in 2021. Many glowing mushrooms were also on display and attracted attention. Dried specimens of the glowing mushrooms were about 5mm in diameter and difficult to observe. *Cruentomycena orientalis* was displayed with a magnifying glass. Therefore, this study examined the use of AR technology to assist in the observation of these small mushrooms to make them easier to observe.

3. AR Application Development

3.1. Development Environment

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

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Table 1. Development Environment

OS	Windows 10 Pro
software	Unity 2020.3.22f1
	Blender 2.93
	Visual Studio 2019
Smart phone	Galaxy S8

3.2. Target mushrooms

The *Favolaschia peziziformis*[Figure 1] and *Cruentomycena orientalis*[Figure 2], which were particularly difficult to observe among the bioluminescent fugi on display at the museum, were the subjects of this study.

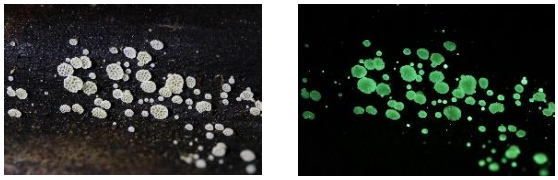

Figure 1. *Favolaschia peziziformis*

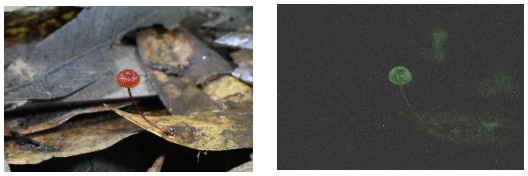

Figure 2. *Cruentomycena orientalis*

3.3. 3DCG of mushrooms

The CG model was created based on the images provided[Figure 3] [Figure 4].

Figure 3. Courtesy image

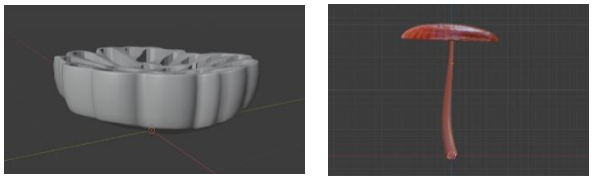

Figure 4. 3DCG models

3.4. AR application

Load an image of a mushroom to be used as a marker, and display a 3DCG model of the mushroom on top of the image in AR. When a marker disappears from the screen, the displayed 3DCG model also disappears, and when the same or another marker is scanned, the 3DCG model appears again. The use of the application is shown below[Figure 5].

Figure 5. Execution Result

4. evaluation experiment

4.1. experimental procedure

The experiment was conducted with the cooperation of 15 students from the University of Miyazaki. The procedure is as follows.

(i) Explain the use of photographs instead of actual specimens and the placement of markers for AR.
(ii) Observe the photo for 1 minute.
(iii) Observe 3DCG models of mushrooms displayed in AR with the developed application.
(iv) After the observation is completed, a questionnaire is administered.

4.2. Questionnaire Results

The questionnaire consisted of 5-point rating questions, yes-or-no questions, and open-ended questions. The closer to 5, the better the result. Fifteen participants in the evaluation experiment answered the questionnaire. The results of the questionnaire are shown Table 2.

Table 2. Questionnaire results

item	1	2	3	4	5
Ease of use of the application	0	1	1	8	5
Ease of observing *Favolaschia peziziformis*	1	1	3	5	5
Ease of observation of *Cruentomycena orientalis*	0	2	2	6	5
Legibility of text above 3DCG mushrooms	0	2	11	1	1
	Yes			No	
discover anything new by using the app	15			0	
use the application in a museum	15			0	

Descriptive questions are as follows:

- Matters to be improved
  - When observing from above, the letters overlap the mushrooms and get in the way.
  - Difficult to observe mushrooms from below.
- What features do you want?
  - Rotation, enlargement, and reduction functions.
  - observe how it glows.
- Other Notices
  - *Cruentomycena orientalis*'s color differs between the exhibit and when observed using the app.
  - Disturbing others in the museum because I have to move when making observations from various angles.

From the survey results:

We consider it an easy-to-use application. Some users commented that loading markers was not smooth. Since the subjects were all in their 20s, smartphone operation and observation went smoothly. There was a comment that the *Favolaschia peziziformis* were difficult to observe. It was found that this mushroom has a characteristic that makes it more difficult to observe from the side than other mushrooms because it is flat. The most common request was to improve the legibility of the displayed text. Many users requested the ability to rotate and magnify the mushrooms displayed in AR. We believe this is an important feature for observing mushrooms in detail.

5. Conclusion

This study aimed to use AR technology to assist in the observation of mushrooms in museums.

The results of the evaluation experiment confirmed the usefulness of the developed application, as all 15 respondents indicated that they had made new discoveries by using the application and that they would use the application if it were introduced in a museum. On the other hand, we found various points to be improved, such as the lack of functions to rotate, zoom in, and zoom out the 3DCG model, which made it difficult to observe. This point needs to be improved because it is directly related to the most important aspect of this study, which is the observation of mushrooms. However, there are many opinions that the labeling of the mushrooms' names is an obstacle to mushroom observation, and since mushroom names are actually displayed and explained in museums, it is necessary to consider how to label the mushrooms. As a future issue, the application will be improved based on the opinions obtained from this evaluation experiment. There are some inadequacies in the evaluation experiment, such as the fact that real mushrooms could not be used, that the age range of the participants was biased, and that the experiment could not be conducted in a museum.

The above results suggest that further progress may be possible in this research. Therefore, we will continue to conduct research and experiments for further progress of this study.

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