

DESIGNING AN INTERACTIVE LEARNING METHOD USING AUGMENTED REALITY ON FOOD CHAIN CONCEPT

Ade Syahputra

Program Studi Teknik Informatika, Universitas Trilogi, Indonesia

E-mail: adesyahputra@universitas-trilogi.ac.id

Abstract

Food chain is one of the fundamental concepts in the ecological biology which describing feeding relationship between organism categories in a food web in order to gain nutrients and energy. The categories have several levels; producer, primary consumer, secondary consumer, tertiary consumer and decomposer. Teaching theoretical biology concept can be difficult for teacher. Conventional methods such as lecturing even with pictures often unsuccessful to engage student attention. Hence, the teaching and learning process failed to reach the goal which is transferring information from teacher to students. To increase interest and understanding of every process that occurs in this food chain cycle, an application using augmented reality technology is developed. Augmented reality is a technology in the field of multimedia that allows users to visualize the two-dimensional or three-dimensional of virtual objects as part of a real-world environment. The visualization of augmented reality will gives a direct or indirect interactive experience to the users by using the specific gadgets. Literatures study and application design are used in this research. The expected results obtained from this research will be the delivery of an interactive three-dimensional visualization of food chain cycle that will provide a better learning experience by utilizing smartphones and tablets.

Keywords: Augmented reality, Biology, Food chain, Interactive learning.

INTRODUCTION

Conventional method is commonly used in teaching biology theoretical concepts in class. However, this methods usually unsuccessful to gain student interest, even when pictures are used. As a result the learning process unable to reach its purposes which is delivering knowledge and information from teacher to students. In order to increase student interest and understanding toward the biological concepts, this research is trying to create an interactive learning method for food chain concept by using augmented reality technology.

Augmented reality is a breakthrough innovation from the concept of virtual reality technology. The technology will allow users to visualize two-dimensional or three-dimensional virtual objects as part of the real world environment. The visualization will provide an interactive experience directly or indirectly to the user through specific device (Azuma 1997). Currently, Augmented Reality is a trend in the mobile industry that allows additional three-dimensional object in real environment image on device such as Smartphone and Tablet.

Food Chain illustrates feeding relationship within organisms in order to gain nutrients and energy (Pramita 2015). Food chain is a fundamental concept in ecological biology. The chain is constructed with several level of categories; primary producers, primary consumers, secondary consumers, tertiary consumers and decomposers. Producers are autotrophic, organisms that able to build organic molecules themselves by using either light or chemical synthesis pathway as an energy source (e.g. plants and phytoplankton). Primary consumers are herbivores that eat plants, algae or fungi (e.g. small rodents, insects, rabbits, humming birds and grassers). Secondary consumers are carnivores, organisms that get their energy by eating herbivore animals (e.g. frogs, snakes and foxes). Tertiary consumers are carnivores that feed on secondary consumers (e.g. eagles, sharks and human). Decomposers are organisms that derive their energy by consuming, nonliving organic matter (detritus) such as dead plants and animals (e.g. bacteria and fungi)

(Reece et al. 2012). Hence, one food chain can be consist of rice plants as producers, rats as primary consumers, snakes as secondary consumers, eagles as tertiary consumers and fungi as decomposers.

Looking at the potential of the Augmented Reality, this research tries to create an interactive learning media by using Augmented Reality on the food chain concepts. In general the process is reading the marker by using smartphone or similar gadget's camera. The camera will detect and identify the marker then displays a 3D object on the screen.

By utilizing Augmented Reality technology, it is expected to provide a better teaching and learning experience. Thus, not only the knowledge transfer from teacher to students can be achieved but also student interest in biology can be increased.

Related work

There are many examples of research that utilizes Augmented Reality as a technology that enables interaction between people and information in 3D. This is because the technology allows a creation of interactive experiences for the user to perform actions that are not possible in the real world (Dede, 2009). Moreno et al. (2001) reported that students were enthusiast toward teaching material provided with animated pedagogical agents. Furthermore, students who are asked to interact with the agent have a better understanding and also more capable to explain what they have learned to other students.

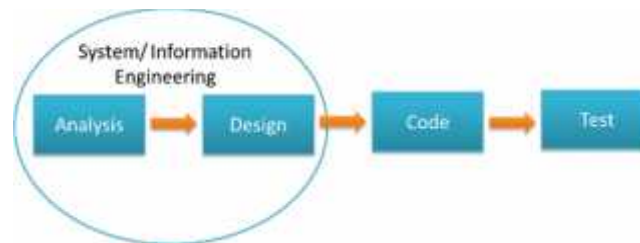
In a study, Vlahakis et al. (2002) demonstrated Augmented Reality as an interactive tool, used on sites of cultural heritage. System tour assistant, named ARCHEOGUIDE AR (Augmented Reality-based Cultural Heritage On-site Guide) provides on-site assistances and reconstruction of the ancient ruins based on user position. Supporting equipment consists of a Head-Mounted Display (HMD), earphones and mobile computing unit. By using this AR device, user can compare the original image with additional 3D reconstruction model of the ancient sites, event thought the original is no longer exist or only in ruins.

Studies by Henderson and Feiner (2009) reported the utilization of AR technology in military sector. The results showed, with the help of AR technology the military mechanic staff can perform routine tasks related to the maintenance of a bulletproof vehicle safely and comfortably. The mechanical staffs were equipped with AR implemented devices such as tracked head-worn display that was designed to facilitate a better understanding, location, and execution of the tasks.

Based on these studies, an interactive learning media focused on food chain concept is designed. The result will give a learning media which is more innovative and attractive either for teachers or students.

METHODOLOGY

The method used in this study is Linear-Sequential Model. Linear-Sequential Model or known as the Waterfall is a model that provides a workflow approach to life-cycle software in a sequential manner starting from analysis, design, coding, testing and support phase (Rosa and Salahuddin 2013).



Source: Rosa A.S. and M. Shalahuddin 2013

Figure 1. Linear-Sequential Model/Waterfall Model

Requirements analysis is an initial stage of the Waterfall Model. The information gathering process is done intensively to specify the software and hardware needed by user. The types of information are searching problems, data collections, and interviews. All software and hardware requirements specification at this stage is need to be documented.

The next stage is the software design. The intended design is a multi-step process that focuses on the design and manufacturing software programs including data structures, interface representation, software architecture, and coding procedures. This phase is translating the software needs from the requirement analysis phase to design representation that can be implemented into the program at a later stage. This will be convenience to the involved programmer or the parties in making the program. Software design that is produced in this stage also needs to be documented.

In the making of the program code, the design will be translated into a software program by the programmer. The result of this phase is a computer program in accordance with a design that has been made at the design stage.

Testing is more focused on the functionality of the software and make sure all parts are tested to minimize errors. Furthermore, this stage is also ensuring that the resulted output is as exactly as intended and can be published.

DISCUSSIONS

This designing interactive learning media by using Augmented Reality technology will generates two items which are:

- Marker, used as a pattern of the three-dimensional object of Augmented Reality, and
- Food chain application which required to be installed to a smartphone or tablet.

Analysis of the requirement of food chain application

There are some features that were developed at the analysis stage, such as:

- The object of each level in the food chain, such as producer, primary consumer, secondary consumer, tertiary consumer and decomposers.
- Marker as coded tools.

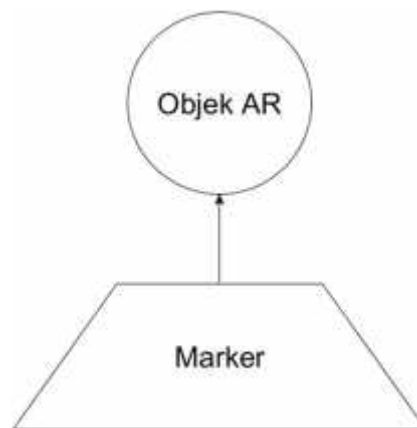


Figure 2. Illustration of Augmented Reality objects

Figure 2 illustrating the process of the emergence of Augmented Reality objects. Marker is used as the pattern to generate three-dimensional objects of the food chain. The food chain's levels will appear by utilizing application installed on the smartphone or tablet.

The specification of required software and hardware in the design of interactive learning method are:

- Vuforia Qualcomm used to create the target marker
- Unity 3D is an application development platform
- Smartphone or tablet with a minimum of android ICS 4.1.3 version

Marker Design

The type of marker used in the food chain application is a QR Code, as shown in Figure 3. QR Code is a unique in terms of shape and pattern to facilitate the differentiation with other patterns.



Figure 3. Augmented Reality Marker

In designing the marker, Vuforia Qualcomm is used to see the precision and accuracy of the marker by giving a rating. Marker rating can be seen from the assessment given by Vuforia Qualcomm through its website which can be accessed after the marker uploaded.



Figure 4. Marker Ratings

Figure 4 shows the results of an assessment of the marker used in the food chain application. The result given by Vuforia Qualcomm is 4 out of 5 stars. Thus, the marker as a pattern is compatible for delivering the appearance of three-dimensional objects.

The design of main scene of the food chain application

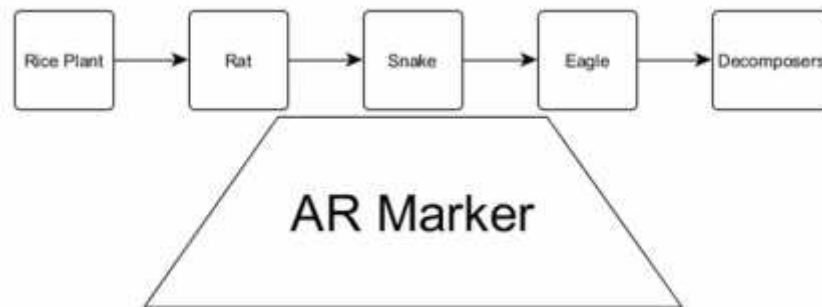


Figure 5. Main Scene

The main scene of the food chain application shows the food chain's levels in three-dimensional forms which are: producers, primary consumers, secondary consumers, tertiary consumers and decomposers. The components contained in the main scene of the food chain application are:

- One object of the rice plant (producer)
- One object of a rat (primary consumer)
- One object of a snakes (secondary consumer)
- One object of an eagle (tertiary consumer)
- One object of a decomposers
- One marker.

The Implementation of the food chain application

To use the food chain application, users are required to install the application to their smartphone or tablet. Then, the user could scan the marker that has been provided. Three-dimensional objects of the food chain will appear on the screen of their smartphone or tablet, as can be seen on Figure 6.



Figure 6. Display of the food chain's objects

Testing of the food chain application

The test is conducted to assess the functionality of the food chain application. Various test-case is performed to ensure the application is designed as expected. Based on the results, the food chain application is function properly. Although the test results indicate a proper functionality, the application can be developed in the future which will offer better appearance, more user friendly and informative.

CONCLUSION

The utilization of Augmented Reality marker on an interactive learning method will give the user better learning experience. Marker is used as a pattern to reveal the three-dimensional objects of the food chain. The emergence of the objects occurs by utilizing the application installed on user's smartphone or tablet. The user could interact directly with the objects by scanning the marker using smartphone or tablet camera.

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ABOUT THE AUTHORS

Ade Syahputra: He graduated from Gunadarma University, Depok, with a degree in informatics engineering and later received a Master's degree in Information and Communications Technology Management from University of South Australia, Adelaide. His research interests include Augmented Reality, Human Computer Interaction, and Supply Chain Management. He currently works for Trilogi University as Informatics Lecturer.