

3D VISUALIZATION OF GLOBAL WARMING LEARNING USING AUGMENTED REALITY

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ABSTRACT

The temperature of the earth is constantly increasing due to global warming. Global warming is caused by increased greenhouse gases resulting from the use of fossil fuels and deforestation. Lack of public awareness of the dangers of global warming causing adverse impact on nature, such as the melting of polar ice caps, rising sea levels and other natural occurrences that threaten human life. Global Warming Augmented Reality can be used as one of the alternative media to provide information about global warming interactively. This application visualize representation using Augmented Reality and detects world map image that is used as a marker with fast tracking. This application can be used to the impact of global warming in the form of a virtual three-dimensional object that will animate the changes that occur in some areas of the surface of the earth from global warming on the world map marker to implement augmented reality technology.

Index Terms— Global Warming, Augmented Reality, Three-Dimensional Object

sea levels, extreme weather and other effects of global

1. INTRODUCTION

Based on data from research conducted by the Intergovernmental Panel on Climate Change (IPCC) in 2007, there has been increasing of average temperature of the earth that is called global warming. One of the causes of global warming is increasing concentrations of greenhouse gases in the atmosphere resulted from the burning of fossil fuels. The impact of global warming, among others, the melting of polar ice caps, rising sea levels, extreme weather and other effects that threaten human life [2]. This can happen due to lack of knowledge and awareness about the dangers of global warming. One means to promote the dangers of global warming is making use of current technological developments giving information about global warming that is delivered in a interesting way and not boring for the public.

2. RELATED WORKS

In a previous study conducted by Danang Kurniawan, Yudi Prayudi, Irving Vitra Papatungan [4] who develop learning aids global warming in Indonesia introduction to the concept of global warming information through interactive multimedia by using images, sound and video. Later research conducted by Evans Wirga [7] that build augmented book Earth's surface on the android platform, which can visualize the shape of the Earth's surface over the image detected by the camera with augmented reality technology.

Based on previous research, the authors will perform development by building applications that can visualize the effects of global warming that occurred at several locations on the Earth's surface such as the melting of icebergs, rising

warming in the form of three-dimensional display over world map image with augmented reality technology. So that people can find out some of the impacts of global warming that has occurred and provide information related to global warming through pictures, video and sound..

3. ORIGINALITY

Application "Global Warming Augmented Reality" is global warming learning applications that visualize what are the harmful effects of global warming using technology-based interactive method Virtuality Continuum namely Augmented Reality. This application not only displays multimedia-based interactive learning but using a new approach, namely Maps Augmented Reality.

4. SYSTEM DESIGN

4.1. General Description

This application will run on computers with Windows operating systems. The application starts with the main menu page consists of: global warming menu, the menu of the application guide, and menu about the application developer. On the menu of warming effect, the camera on the user's computer is turned on and there are signs to direct the camera to the map image.

After the map is detected by the camera, the user's screen will display several locations of global warming impacts. Users can choose any point of the site and will get a visualization of the effects of warming in the form of three-dimensional animations that will appear over the image map by applying augmented reality technology. Visualization shown include melting icebergs, rising sea levels, extreme weather, drought and other effects of global warming. At each three-dimensional visualization displayed, the user will get information about the warming effects through sound.

4.2. System Architecture

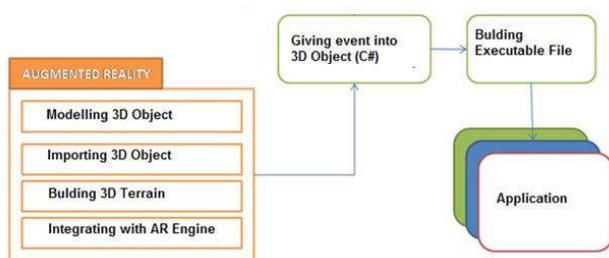


Figure 1. System Architecture

Maps Augmented reality used to visualize the effects of global warming. Input the application form three-dimensional objects are created on stage Terrain 3D modeling and object created in step 3D terrain, 3D objects that have formed integrated with augmented reality engine MetaioSDK, and the final results in the form of a file applications with the application installer form.

4.3. System Building

The process of making an application made in accordance system architecture shown in Figure 1. It consists of several process follows.

a) Modeling 3D Objects

The initial step in building this application is modeling of 3D objects that will be used in the application. 3D base object cuboid called mesh are formed in accordance with the requirements by doing extrude process, rotating and scaling. Then 3D objects are given texture taken from an image that corresponds to the required texture. 3D objects creation is shown in Figure 2.

MESH; EXTRUDE, ROTATE, SCALING; TEXTURING



Figure 2. Modeling 3D Object

b) Importing 3D Objects

The next stage is to import 3D objects which have been made into Unity 3D editor which can be done by importing 3D objects with .blend extension into the Unity 3D Asset column.

c) Building 3D Terrain

At this stage, the Earth's surface contour formed by using the 3D Terrain features in the Unity editor with the following stages:

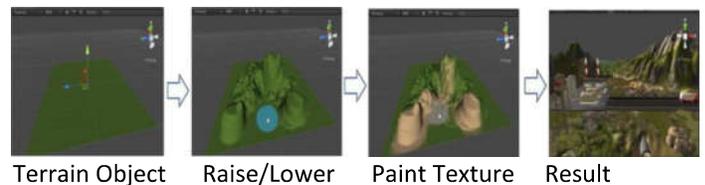


Figure 3. Building 3D Terrain

d) Integrating with AR Engine

The next step is the integration with Metaio SDK with 3D objects by using the Unity3D editor as shown in the picture below.

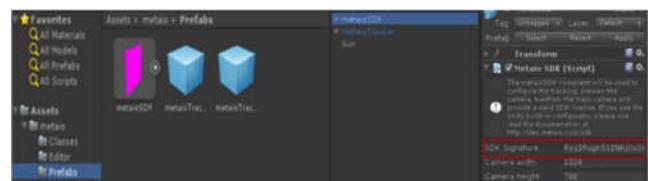


Figure 4. Integration Steps with AR Engine

At this stage, the xml file is configured to set the image that will be detected and the method that will be used in the detection process. Stages of detection in the image shown in the following figure.

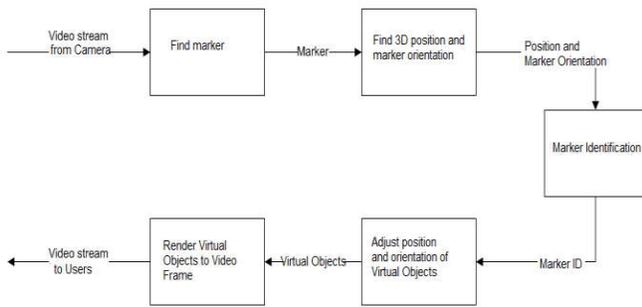


Figure 5. Stages Of Marker Detection On The AR System.

e) Giving Interaction to the 3D Objects

The next step is to give the event to build interaction between virtual objects with the user by using C# programming. Such as program to run a video file, the program for navigation in virtual environments, and program that is used to access the AR objects.

f) Building Application

The last step is to build applications into .exe files that the user will use to execute the application on the computer with the Windows operating system.

5. RESULT

From the results of the implementation of the above system, the design are obtained in the form of executable files of applications that can be executed by the user on the computer with the Windows operating system. In the figure 6 is shown the result of global warming video.



Figure 6. Application Menu : Global Warming Video

Results of Global Warming Impact Menu is shown in Figure 7, which shows the location of the point of impact of warming in some regions of the earth. Among others, melting icebergs, sea level rise, extreme weather, floods,

droughts, forest fires and deforestation that occurred in several locations on earth.



Figure 7. Warming Impact menu that displays the location of the point on the map image

In Figure 8 and 9 show the visualization of the effects of warming in the form of 3D objects displayed on a world map images successfully detected by the camera.



Figure 8. Animation of iceberg in Antarctica



Figure 9. Animation of Flood as Impact of Global Warming

5.1. Performance

Table 1 Result of Performance Testing

Devices	Augmented Reality (fps)
ASUS A44H	48
LENOVO B940	51
ASUS A42JC	55
HP ENVY 6	445

The test results showed that the application of applications can run on multiple devices of different devices, the performance of the application to adjust the hardware

specifications used. The application runs fine on devices with a minimum 2.2 GHz processor specs, at least 2 GB of RAM and VGA at least 1 GB.

5.2. Marker Materials

Table 2 Result of Marker Detection Testing

Marker	Materials	Result
World Map	HVS Paper	Detected
World Map	Inkjet Paper	Detected
World Map	Glossy Paper	Detected
World Map (Globe)	Globe	Not Detected

The images can be detected well for images that have a flat surface and made of materials that are not shiny. Materials are detected include HVS Paper, Inkjet Paper, Glossy Paper, while the paper is on props globe not successfully detected.

5.3. Detection Distance

In tests performed on the distance detection, detection performed on several images at a certain distance. The results showed that the camera can detect a wide variety of images with both the detection distance below 40 cm.

5.4. Detection of Images in Parallel

Applications that have been built to detect multiple pictures simultaneously up to 5 pictures. The required time for detecting the image will increase as more images are detected simultaneously.

5.5. Detection Method

Table 3 Result: Fast dan Robust Tracking Method

Marker	Method	Detection Time (seconds)				
		P1	P2	P3	P4	P5
Marker 1	Fast	0.91	0.88	0.89	0.90	0.88
Marker 1	Robust	1.21	0.95	0.92	0.92	0.90
Marker 2	Fast	0.67	0.70	0.60	0.65	0.71
Marker 2	Robust	1.32	0.88	0.85	0.86	0.83
Marker 3	Fast	0.67	0.73	0.70	0.71	0.69
Marker 3	Robust	1.34	1.20	0.87	0.82	0.86

With Fast Tracking method, application can detect multiple images simultaneously and provides a faster detection time. While the method of Robust Tracking takes longer detection time but robust detection results so that the displayed 3D object on the screen is not easily lost.

5.6. User's Opinion

The application has been tested on 30 user consists of elementary to high school students, college students and employees or employees through questionnaires and interviews with the following results:

Table 4 Result of Users Questionnaire

NO	Description	Result	
1	Applications can run smoothly on the user's computer.	Strongly Agree	16 %
		Agree	94 %
		Weakly Agree	0 %
		Not Agree	0 %
2	Application operated easily	Strongly Agree	6 %
		Agree	91 %
		Weakly Agree	3 %
		Not Agree	0 %
3	Application Interface is interesting	Strongly Agree	69 %
		Agree	31 %
		Weakly Agree	0 %
		Not Agree	0 %
4	The information is complete	Strongly Agree	9 %
		Agree	88 %
		Weakly Agree	3 %
		Not Agree	0 %
		Strongly Not Agree	0 %

NO	Description	Result	
5	The Information is easy to be understood	Strongly Agree	6 %
		Agree	84 %
		Weakly Agree	9 %
		Not Agree	0 %
		Strongly Not Agree	0 %

6. DISCUSSION

From the results of the implementation and testing of the system that has been done, the result that the application can visualize the impact of global warming in the form of a virtual three-dimensional object that will display the animation changes that occur in nature as a result of global warming on the world map images are detected through the camera. The results of this study indicate that the application running on the Windows operating system is influenced by several factors: the device used specifications, materials and fields that are used as a marker detection, detection range, the marker, the number of markers detected in parallel, and the detection method used. Use of Fast Tracking application method provides faster detection time compared with Robust method as shown in the graph below.

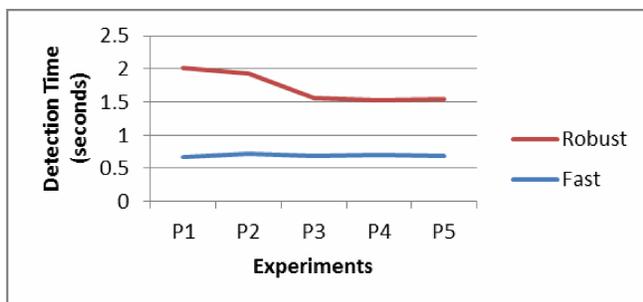


Figure 10 Comparison of Detection Time Using Fast and Robust Method.

This application has been able to detect a wide variety of images and photos printed on a plane (two dimensions). Development that can be done in applications such as developing applications on the mobile platform and develop augmented reality technology to detect directly on objects that are in nature.

7. CONCLUSION

Based on the test results and the objectives of this research, it was concluded as follows:

1. This application can be used to visualize the impact of global warming and provide information about the dangers of global warming.
2. Image detection process is affected materials and fields that are used as a marker detection, distance detection, pattern and color variations on the marker. the number of markers detected in parallel, and the detection method used.
3. Applications using the Fast Tracking method to detect markers to get a faster detection time.
4. The test results indicate that the users of the application application performance is quite good, the design of interesting applications, information is complete and easy to understand as well as the operation of the application is quite easy.

8. REFERENCES

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