PERFORMANCE ANALYSIS OF MARKERLESS AUGMENTED REALITY ON MOUNT MERAPI MAKET AT THE CENTER FOR INVESTIGATION AND DEVELOPMENT OF GEOLOGICAL DISASTER TECHNOLOGY

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INTRODUCTION

- The National Disaster Management Agency recorded that there were 398 fatalities, nearly half a million people displaced, and material losses amounting to Rp 3.5 trillion during the eruption of Mount Merapi in 2010.
- Educational programs are designed to foster and enhance knowledge, understanding, and awareness of the surrounding natural conditions and the skills to reduce risks in the event of a disaster
- One of the digital media that can be used to provide education on Mount Merapi disaster mitigation is Augmented Reality (AR) with the 3D Object Tracking method.
- Augmented Reality (AR) has the capability to integrate virtual objects, both in 2D and 3D forms, into real-world environments.
- Currently, there are two main AR methods being developed: Marker-Based Tracking and Markerless Tracking.

INTRODUCTION (CONT...)

- Marker-Based Tracking is an Augmented Reality method that utilizes object markers with specific patterns that are read by a computer through a webcam or camera to trigger the appearance of virtual objects.
- The effectiveness of object detection in these systems is influenced by factors such as camera focus mode, lighting conditions, target size, print quality (for two-dimensional targets), camera angle, and object features.
- Therefore, it is essential to consider environmental lighting, distance, or surface conditions during the design and implementation phases of Augmented Reality to ensure an optimal user experience under various usage conditions.

RESEARCH METHODOLOGY

Data Collection

1. The data collection methods consist of the following stages:

a. Observation

Data Collection through observation is conducted by visiting BPPTKG (Center for Research and Development of Geological Disaster Technology) and examining the collections displayed in the exposition room.

b. Literature Review

Data collection through literature review is carried out by searching for journals and articles relevant to the research.

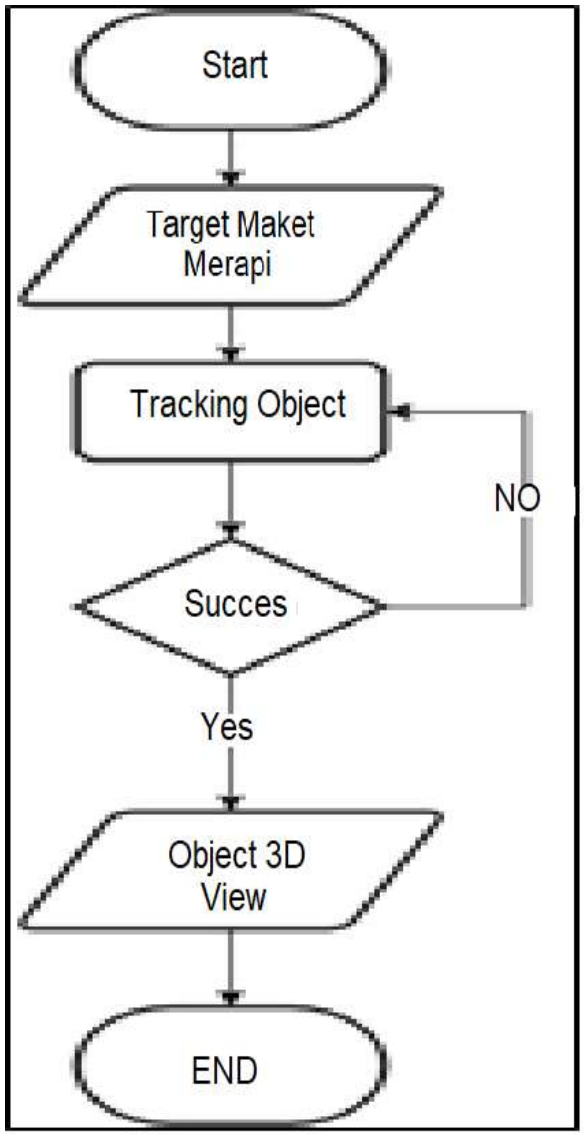
2. Concept

The concept stage is the first phase in system development using the Multimedia Development Life Cycle (MDLC) method

3. *Design*

This phase aims to create the design, including flowchart diagrams, navigation structure, storyboard, and user interface.

FLOWCHART


Start
Target Maket
Merapi
Tracking Object
NO
Succes
Yes
Object 3D
View
END

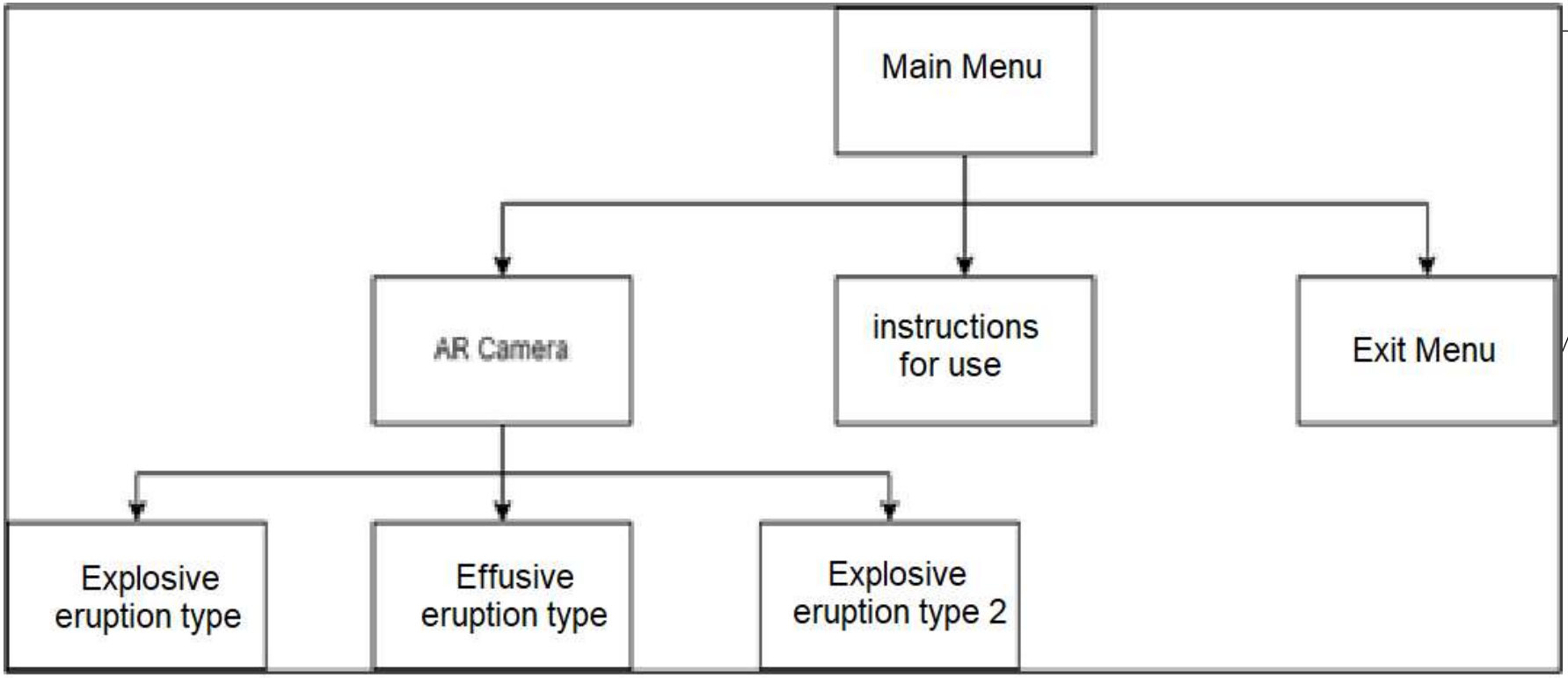
ERUPTION STORYBOARD

No	Storyboard	Notes
1		Initial eruption
2		The volcanic materials erupt high and spread widely, making the explosion even larger
3		The explosion starts to subside again
4		The mountain returns to normal

EFFUSIVE STORYBOARD

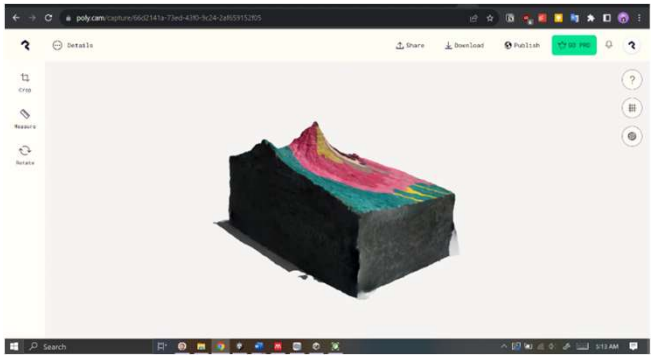
No	Storyboard	Information
1		Effusive eruptions gradually release material in the form of pyroclastic clouds.
2		The material being expelled increases, causing the pyroclastic cloud to expand.
3		Like smoke, the pyroclastic cloud will rise and gradually dissipate.
4		The mountain returns to normal

DESIGNING NAVIGATION STRUCTURE



MATERIAL COLLECTING

The material collection phase involves gathering the necessary resources for the project. The primary requirement is the Target Model, which is the Mount Merapi model located in the BPPTKG Exposition Room



3D Scanning Mount Merapi

Assembly

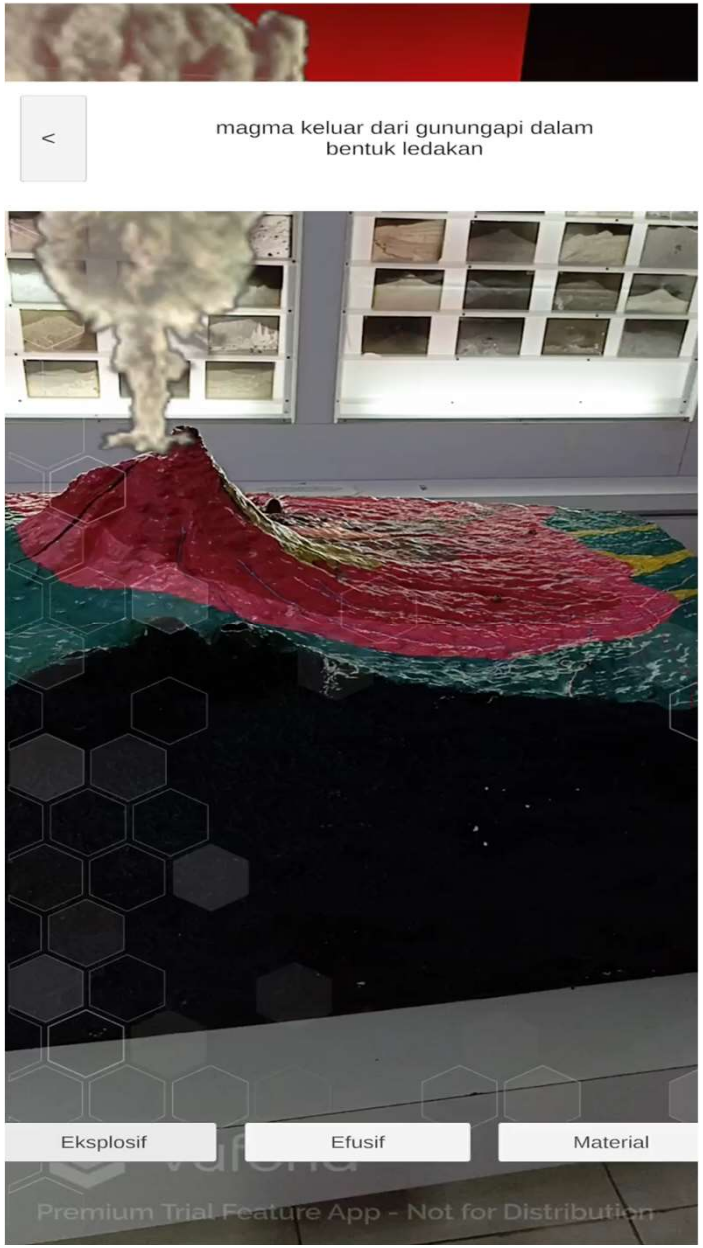
The assembly stage is the process of creating all objects or multimedia materials. The application is tailored to match the design flowchart, navigation structure, and user interface. The integration of the application is done in software Unity.

Testing and Sistribution

Testing using beta test and The distribution plan involves scanning a QR code that will direct users to Google Drive.

RESULTS AND DISCUSSION

The implementation of the interface in the Mount Merapi Augmented Reality Model Application results in three pages: the main menu, AR Camera, and usage instructions


magma keluar dari gunungapi dalam bentuk ledakan
Eksplosif
Efusif
Material
Premium Trial Feature App - Not for Distribution

THE APPS

FUNCTIONAL TESTING

Question	Evaluation				Percentage
	SK	K	B	SB	
Accuracy and word choice in the information provided			1	9	97.5%
Button function accuracy in achieving the desired purpose				10	100%
Menu function accuracy in achieving the desired purpose				10	100%
Animation accuracy and virtual object usage			4	6	90%
Animation speed and virtual object appearence			3	7	92.5%
			8	42	96%

APPEARANCE TESTING

Question	Evaluation				Percentage
	SK	K	B	SB	
Selection of display and font size usage		1	5	4	82.5%
Choice of text and background colors		1	3	6	87.5%
Selection of button colors and sizes		1	4	5	85%
Overall accuracy of layout arrangement		1	3	6	87.5%
Animation accuracy and virtual object sizes			2	8	95%
		4	17	29	87.5%

USER EXPERIENCE TESTING

Question	Evaluation				Percentage
	SK	K	B	SB	
Overall comfort of the application			1	9	97.5%
Ease of operating				10	100%
Navigation clarity within the application			1	9	97.5%
Usefulness of the provided information				10	100%
Augmented reality effectiveness in making mount Merapi mitigation education more interactive			1	9	97.5%
			3	47	98.5%

DISCUSSION

- In target testing, 24 trials were conducted with an 87.5% success rate.
- The distance of 70 cm with 50% and 30% of the surface obscured on the rear side, there were some errors in target detection.
- The experimetnts using distance of 70 cm, two detection errors occurred due to the proximity and the presence of textures resembling the peak of the Mount Merapi model.
- The distance of 70 cm and 50% of the surface covered, the object was not detected.
- The ideal usage distance for the application is no less than 70 cm, with a minimum of 30% of the object covered.
- The closer the camera is to the target, the more difficult it becomes for the camera to scan the entire target.
- the user experience smoothness testing achieved a result of 98.5%. This indicates that the user experience aspects of the Mount Merapi Augmented Reality Educational Mitigation application are excellent.
- The overall testing results, including Black Box testing, target testing, and Beta testing, demonstrate the application's effectiveness.
- The use of Augmented Reality for disaster mitigation education aims to enhance the interactivity of the learning experience.
- Data collected reveal that the information provided by the AR Mount Merapi application can be used for educational purposes, with a 100% rating indicating its suitability for learning.
- The interactivity of the Augmented Reality application received a rating of 97.5%, showing that Augmented Reality significantly enhances the interactivity of disaster mitigation education for Mount Merapi.

CONCLUSION

1. The application performs well from the front, right side, and left side. At the rear side, the application functions properly at a distance of 130 cm if there is coverage on the surface of the model.
2. The Black Box testing result is 100%, functionality testing achieved 96%, visual aspects received 87.5%, and user experience smoothness scored 98%. These above-average results indicate that the application is suitable for use.
3. It is recommended to reclassify buttons based on eruption type, primary hazards, and secondary hazards, as the current categorization into explosive, effusive, and material buttons is less appropriate.
4. The user interface and the text explaining the materials should be improved. The current text does not align well with user interaction, so the explanations should be clarified to enhance readability and understanding.
5. Additional testing is recommended in the future to obtain more accurate and representative data.

THANK YOU