3D virtual environment of Taman Mini Indonesia Indah in a web

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Abstract. Taman Mini Indonesia Indah known as TMII is a largest recreational park based on culture in Indonesia. This park has 250 acres that consist of houses from provinces in Indonesia. In TMII, there are traditional houses of the various provinces in Indonesia. The official website of TMII has informed the traditional houses, but the information was limited to public. To provide information more detail about TMII to the public, this research aims to create and develop virtual traditional houses as 3d graphics models and show it via website. The Virtual Reality (VR) technology was used to display the visualization of the TMII and the surrounding environment. This research used Blender software to create the 3D models and Unity3D software to make virtual reality models that can be showed on a web. This research has successfully created 33 virtual traditional houses of province in Indonesia. The texture of traditional house was taken from original to make the culture house realistic. The result of this research was the website of TMII including virtual culture houses that can be displayed through the web browser. The website consists of virtual environment scenes and internet user can walkthrough and navigates inside the scenes.

1. Introduction
Indonesia is a big country and has a long history in its development. A number of cities in the country of Indonesia have a collection of art, culture and knowledge. In the New Order government there was idea of the first lady (Madam Tien Soeharto) to create a park that contains representations of art and culture from all provinces in Indonesia. Taman Mini Indonesia Indah (TMII) is a place or location used to store art and cultural products coming from all provinces in Indonesia, especially traditional houses and art products. TMII preserves art and cultural collections as well as other historic objects. TMII is open to the public so it can be visited by the general public. TMII has a goal to serve the needs of art and cultural information for the community, recreation facilities and to increase public knowledge. With the existence of TMII the general public can find art and culture coming from all provinces in Indonesia although never visited other provinces.

There are many ways in which the TMII to attract people to visit there. By providing information through a number of books, it is also available in other print media as well as through a number of websites. Submission of information through the print media and websites that exist so far is not enough, because many objects and objects (traditional houses, buildings, and parks) which is objects or 3 dimensional (3D) environment. 3D model and 3D objects surroundings will not be intact if the real
objects are displayed only through images. Thus it is necessary to be able to display or visualize real objects in 3 dimensional. In this way, objects and environments can be displayed as their original form, so it will be more interesting and the information conveyed becomes meaningful/intact.

One of the objects that placed in TMII is a traditional/culture house. This traditional house is a representation of 33 provinces of Indonesia. The culture houses which are placed in TMII are as shown in figure 1 below.

![Figure 1. Traditional/Culture Houses of Provinces in TMII](image)

Figure 1 shows the traditional houses from provinces of Indonesia in TMII which is taken from the current website is short description about those culture houses [1]. The information was provided only in the form of text, then the internet user does not know the details about the form or appearance and ornament of the culture houses. This problem can be solved if the information about the culture house is not only in the form of pictures and description, but by using 3D visualization. The internet user or the person seeking information will know more details of the culture house because it is visualized like the original object.

From the background, then in this research was developed a way to be able to display the original culture house (object) by visualizing it in the form of virtual display / virtual. The texture of the object was taken from the texture or color of the original culture house. The information delivery method can use computer graphics technology. By using computer-based graphics technology, it can be developed the website that can be showed 3D objects (culture house) through the internet browser. Utilization of web-based virtual reality technology can visualize the culture house and its environment in TMII virtually so the people will know more detail of every culture house. The benefit of internet users was they can walkthrough to the virtual scene of culture houses.

1.1 State of The Art Research in Virtual Reality
The development of virtual environment in the form of 3D has been done by a number of researchers. Batty et. al has made the virtual world in the form of 3D city [2]. Similarly the modeling of the city has been made from Shiode in his article on the creation of an urban environment in the form of 3 dimensions [3]. Another research was the developing city models for focus based tour animations [4]. This work on a strategy for the dynamic generation of 3D tour animations through a virtual city and landscape model that is optimized for a specific tour. These previous development of the virtual world has not been developed on the web based.

The latest Virtual Reality technology enables displaying 3-dimensional models via the web, the WebGL (Web Graphics Library). The developer does not require a plug-in on Web browsers where the
previous VRML technology was required. It is a Javascript API that can be used for processing 2D and 3D graphics on the Web. Developers take advantage of rendering an animation using Javascript, Web pages, and standard Web stack technology without using plug-ins.

WebGL is part of HTML5 technology, because it is packaged in some browsers that support HTML5 technology. WebGL can work on some desktop and mobile based browsers. WebGL is evolving and making web searches more beautiful in appearance as it displays a moving visualization, from a game to data visualization. WebGL was developed by the Khronos Group, which is an institution that also governs OpenGL, and is a free, inter-platform API that brings OpenGLES 2.0 to the web as a 3D drawing context in HTML.

A number of previous studies that utilize WebGL to be able to display 3-dimensional objects in large sizes, for example to produce virtual museums [5]. This makes it possible to create applications like 3D catalogs of artifacts, or to interactively explore Cultural Heritage objects in a Virtual Museum on mobile devices. Another implementation of WebGL used for developing Cultural Heritage [6]. This research presents a database schema to organize not only segmented models but also different Levels-of-Detail and other representations of the same entity. It is further implemented in a spatial database which allows the storing of geo referenced 3D data. In Cultural Heritage Learning [7], the article further discusses these common attributes on user requirements and subsequently recommends potential solutions to wherever applicable. Another research which used virtual reality technology was to develop Cultural Artifacts [8], Virtual Educational [9] and Huge City Model [10].

This research used Unity 3D that used for several things, such as for model visualization, creating 3D games and animated objects. Unity3D WebGL allows developers to generate 3-dimensional VR models that can later be displayed through a web browser.

Previous research that has been done was the research on the developing 3-dimensional model and web-based virtual reality in National Monument and its environment [11]. This research has been produced 3-dimensional models of the National Monument and the static and dynamic objects. The texture of the object is adjusted to the original so that the result of making the 3D models corresponds to the real condition of the National Monument. Figure 2 shows the results of the making web based of the National Monument. In addition to the creation of 3-dimensional model for National Monument, the research also created other objects contained around the National Monument, among others, a number of park and statues that placed in the park.

![Figure 2. National Monument in a Website](image)

2. Methods

The research method of developing 3D model in a web, basically there are two main things, i.e. modeling and visualizing in the form of virtual reality. It was needed to be prepared number of steps so that the end product of the 3D modeling of the TMII and its objects surrounding area can be displayed visually on the Web. Users can explore the 3D models and its environments by controlling buttons on the
keyboard or by using other control devices (mouse). The research method in this research is as in figure 3.

![Diagram](image.png)

**Figure 3.** Step by step of Research

The research was begun by analysis. We have analyzed what software, hardware, tools and technology which is needed to generate a web-based virtual reality application. We also has analyzed about the environment of TMII. The next step is data and information collection, where this step was done by visiting the location of TMII. This step was collected information of culture houses: shape, dimension and texture of objects. 3D modeling (using Blender software) step created the 3d model from real culture houses and the objects that exist in the form of three-dimensional graphic models. The step continued with developing virtual reality model with Unity3D software. The research continued with creating VR website, converting the 3-dimensional model that has been created in the form of virtual reality that can be showed with a web browser and developing a website. Testing step was testing of the models with examining the models to display whether the model correct or error to display. The virtual culture house was tested from errors, if the texture was missing to display. Test activity also including measuring the loading time of every scene to display in the website.

2.1. Website Design
The website was designed in 5 main menus. The menus are: culture houses, TMII in virtual reality, history of TMII, about virtual reality and about us. Culture houses menu shows the list of houses and the description about the house, TMII Virtual Reality consists of many pictures of culture house in virtual reality, History of TMII consists of the history of TMII, About Virtual Reality menu shows the Virtual Reality and how to use or navigate virtual reality, and About us. VR technology based website design can be seen in the form of navigation as seemingly structure in figure 4.

![Diagram](image.png)

**Figure 4.** Navigation Structure of Website

3. Result and Discussion
Result of this research was a website of three-dimensional model of traditional/culture houses and the objects surrounding the environment, which can be displayed in a web browser. The research data have been taken from the real TMII. Texture data taken from real TMII and then added to each object as original object. To generate the texture according to the dimensions of the original model, adding some texture on large objects must be adapted to the actual dimensions.
Virtual Reality shown through the website is placed in TMII Virtual Reality menu. Virtual reality modeling was placed by dividing into a number of scenes, where every scene consists of specific traditional/culture house. This was done due consideration of the size of large models that will be hard for a computer that is used when rendering.

In the TMII virtual reality culture houses menu, there are 33 culture houses of the Indonesia provinces in VR which can be accessed by the user. At any existing VR models, users can perform a walk-through using the keyboard by pressing the up arrow, down left and right. The website and virtual environment of some culture houses looks beyond is as shown in Figure 5.

![Figure 5. TMII Virtual Reality Website.](image)

Figure 6 shows the virtual reality sample of traditional/culture house from Kalimantan Barat and Yogyakarta. The scenes consist of virtual culture house including the vegetation and static objects surrounding the environment.

![Figure 6. Scene of (a) Kalimantan Barat Culture House, (b) Yogyakarta Culture House](image)

The first testing was to see 3d model and the texture of the virtual culture houses comparing to original culture houses. Figure 7 shows the comparing of one original and virtual culture house.
Next testing was a loading time testing. This website has been tested by measuring loading time of the scenes. Table 1 shows the result of testing of some culture houses scene.

Table 1. Testing of some culture houses scene

| Culture House Scene Name                     | Loading Time (Second) |
|---------------------------------------------|-----------------------|
| Yogyakarta Culture House                    | 1.59                  |
| DKI Jakarta Culture House                   | 1.43                  |
| Kalimantan Barat Culture House              | 4.76                  |
| Kalimantan Timur Culture House              | 1.51                  |
| Sumatera Selatan Culture House              | 1.49                  |

The table shows the different size of scene and loading time. The size of scene was small and the loading time was also not take time. This research has been developed scenes mechanism efficiently, while whole of the asset for the scene placed in one folder, and for every scene which will be loaded, can used these assets directly. The website has been tested in Mozilla fire fox browser and user can walk-through and navigates in the scene smoothly. The website will be published in URL www.vr-tmii.com. User navigation was tested using keyboard and mouse to walk-through in virtual culture houses.

4. Conclusion
This research has successfully generated virtual environment of traditional/culture houses in Beautiful Indonesia Miniature Park (TMII) and objects surrounding the environment. The virtual model of the culture house was successfully displayed in a web. The testing results showed that virtual model can be displayed in the web and the internet user can walk-through real time to navigate in that virtual scene. Users can easily control the virtual reality models with a keyboard and mouse.

The next development will add virtual environment with more dynamic object or animated elements in it, such as a human and moving vehicle.

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