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Supplementary Factual Data An Encyclopaedia of Land Transportation Models in Jakarta Using Multimedia Technologies

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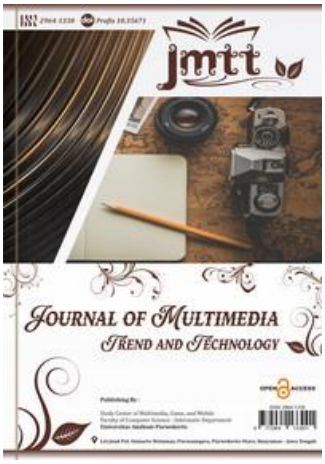

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ABSTRACT

The development of multimedia technology in various learning applications shows an increasing trend. According to the source (Head of IT Division AR & Co Indonesia) "the future of Augmented Reality has many advantages compared to Virtual Reality because users can see and touch digital objects and can interact with digital elements. Using Augmented Reality technology means that it will give birth to a new type of interaction between humans and computers". Therefore, research was conducted to create an encyclopedia of Jakarta transportation using augmented reality technology. This encyclopedia book is in the form of a book containing seven models of Jakarta transportation with a marker in the form of a QR-code. Each marker on each page displays a three-dimensional model of transportation along with its animation. This encyclopedia book about Jakarta transportation was created using the ARToolkit library software. To create a three-dimensional organ using the Blender 2.64 application, while making the marker using Adobe Photoshop CS4. The output of this application is in the form of a three-dimensional vehicle model along with animation that will be seen and the webcam is highlighted on the marker.

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INTRODUCTION

The use of multimedia technology in various types of applications is needed to package an application into an interesting application, especially in terms of learning[1]. Books are a window to the world because only by reading can you find out everything amazing about the outside world[2]. Reading can also improve the quality of human life and keep you away from the abyss of ignorance. Reading books will increase knowledge about what exists and what happens in this world[3].

Augmented Reality (AR) technology has many benefits in various fields, especially because of its ability to combine the digital world with the real world in an interactive way[4]. AR enables more engaging learning by displaying 3D content that students can interact with directly, such as visualizations of the body's anatomy, scientific simulations, or historical scenes[5]. AR can be used for training in difficult or dangerous situations in a safe environment. For example, pilot training, medical operations, or military training. AR allows customers to virtually try on products, such as seeing how furniture will look in their home or trying on clothes without having to physically wear them. AR can assist doctors and medical personnel during procedures by displaying important information such as a mapping of the patient's anatomy or a surgical guide in real time[6]. Technicians can use AR to see step-by-step instructions when performing repairs or maintenance on machines, increasing efficiency and reducing errors[7]. AR can provide additional information about tourist attractions, such as the history of buildings or artefacts, which are directly displayed via a smartphone or other AR device[8]. Overall, AR enhances the interaction between users and digital information, making experiences more immersive, efficient, and engaging in various sectors[9].

AR allows users to interact with digital content directly in a real-world environment, creating a more immersive and engaging experience than traditional media[2][3]. AR enables the visualization of objects or data in 3D, which helps in understanding complex concepts, such as in education, product design, or medicine. In industry and manufacturing[10], AR can be used to provide live instructions and visualization of assembly or repair processes, reducing the time needed for training and reducing errors[9][11]. AR can enhance the user experience in consumer applications such as e-commerce, where customers can virtually try on products before purchasing, or in gaming, where the real world is enhanced with digital elements[12]. AR enables a more personalized and tailored experience for each user, for example, in shopping or gaming applications, which can be adapted based on the user's preferences or environment[13].

According to Senja Lazuardi (Head of IT Division AR & Co Indonesia) "the future of Augmented Reality has many advantages compared to Virtual Reality because users can see and touch digital objects and can interact with digital elements. By using Augmented technology[14].

Reality means that it will give birth to a new type of interaction between humans and computers"[15]. The encyclopedia of land transportation models in Jakarta utilizes this AR-based technology as one of the applications of interaction between humans and computers. The encyclopedia displays objects of images of the transportation in 2 dimensions, along with explanations in 3 dimensions so that readers feel interested and do not get bored reading the book.

In making this Augmented Reality-based encyclopedia book, the means of transportation operating in DKI Jakarta Province are taken, including Transjakarta Buses, Taxis, Kopaja Buses, Angkot, and Trains. The target of making this encyclopedia book is aimed at the community, especially early childhood children, to learn more about the means of transportation operating in the Capital City area. The purpose of this writing is to create and build an encyclopedia book "Land Transportation in Jakarta" using Augmented Reality as an interactive and creative visualization media.

METHOD

The research will use the System Development Life Cycle method with the following stages:

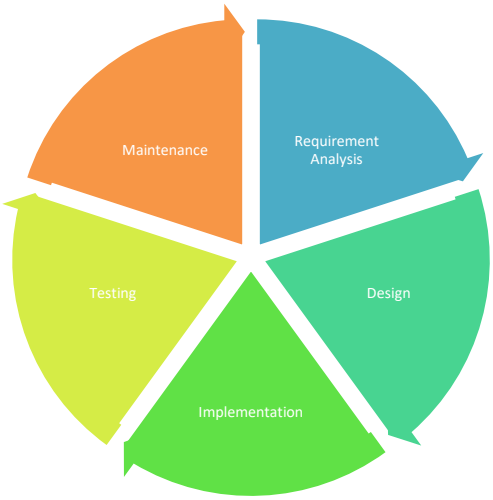

Figure 1, System Development Life Cycle.

Software Development Life Cycle (SDLC) is a framework used to plan, develop, and maintain software systems[16][17]. SDLC consists of several stages, each with a specific purpose and interrelated to ensure effective and efficient software development. Here is the general flow of SDLC:

1. Planning stage, identifying business values in the application. Its purpose is to define the objectives, scope of the project, and resources required. This includes budget planning, schedule, and feasibility analysis. Its activities are identifying business needs, establishing a project team, and developing a project plan.
2. Analysis stage, the first step begins analyzing, collecting information, creating process models and data models. Collecting and analyzing user or business requirements for the software to be developed. Conducting interviews, surveys, or workshops with stakeholders to understand their needs, and documenting the requirements specifications in an SRS (Software Requirements Specification) document.
3. Design stage, designing the images used, designing the architecture, designing the interface, designing the program and markers. Creating architectural and detailed designs of the system based on the needs that have been analyzed. User interface (UI/UX) design, database design, and system architecture design. This also includes decision making regarding the technology to be used.
4. Implementation stage, creating objects and creating markers according to the design. Trial implementation of program results. Building and developing software according to the design that has been made. Writing code by the development team, integrating system components, and creating software modules. At this stage, development is carried out based on the programming language that has been selected.
5. Testing, Ensuring that the software works according to the specified requirements, and is free from bugs or errors. Unit testing, integration testing, system testing, and acceptance testing (UAT - User Acceptance Testing). Each component is tested individually and together to ensure the software functions properly.

6. Maintenance. Ensuring that the software continues to perform well after deployment and can adapt to changing user or environmental needs. Bug fixes, security updates, and new features are added based on user feedback. Maintenance also involves monitoring the system to ensure optimal performance.

RESULT

In this first phase of the study, which is the initial phase, several methods of discovery are used to conduct observations, questionnaires, and surveys. Additionally, resource based on literature research is sought to identify or investigate user needs, which are carried out by searching through user databases. Because research on developing a good UI/UX concept is based on user needs, researcher assumptions also need to be verified to ensure that bias in product development doesn't occur. Next is to make a plan, in making it we use the ARP Tool Kit to make it easier to make the augmented reality system. Here is an overview of the use of the AR Tool Kit:

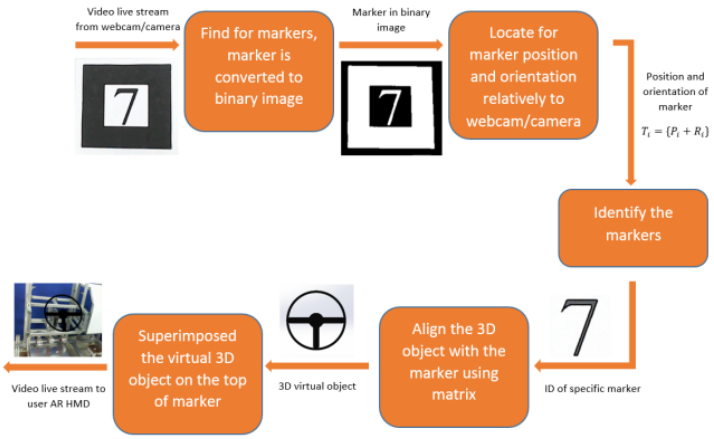

Figure 2, Design flow in AR Tool Kit.

Marker Detection is the stage where the Marker will be identified by the webcam as a target for placing the object to be rendered. Marker Detection using the Hough Transform method detects geometric parameters. The line representation of the Marker captured by the webcam camera uses (r = x cos (θ) + y sin (θ), r: distance between lines in camera calibration, θ: angle between the normal line and the x-axis). The input is a binary value of the corner point (edge) that connects the lines where all the corner points are defined as pixels. Hough Transform requires an array called an accumulator array, this array only has 1 return value for each possible combination of parameters (r, θ). Each line can be built by connecting the corner points (edges) that have been defined as pixels, and the parameters associated with r and θ determine the increment value of the accumulator array. After all possible lines are processed, the high array value represents a line (Marker border). Markers that are successfully detected will be marked in red and green. That indicates the projection or viewing angle of the webcam.

The design stage begins with the creation of a schematic of an augmented reality-based Jakarta transportation encyclopedia book that will be developed. The following is a schematic of an augmented reality-based Jakarta transportation encyclopedia book.

Figure 3, Concept design of using Augmented Reality

From the visible scheme, the structure of the encyclopedia book consists of 2 parts, the first in physical form in the form of a book and the second is the augmented reality application itself which is desktop-based.

1. Explanation of how the media works as seen from the scheme above:
2. The marker from the encyclopedia book is detected by the camera as video input.
3. The incoming video marker will be read by the application and identified as a pattern with a certain ID.
4. The application will call the 3D object according to the read pattern ID. The application that has been read is then displayed above the marker via video output.

Then enter the stage of making transportation objects. In the Encyclopedia Book, 5 three-dimensional objects are needed to introduce the means of transportation in Jakarta. The objects needed include Train, Transjakarta, Kopaja, Angkot, Taxi and all objects. All of these objects are made using Blender software which will later be imported into 3dMax in the form of .obj, then in 3dMax they will be exported to the .wrl folder in the ARToolkit folder. The following are the overall results of making 3D objects that have been made and used as objects in the encyclopedia book "Jakarta Transportation Tools".

Figure 4, Design 3D of Transportation.

To create a marker, you can use the Paint application or Adobe Photoshop. In general, markers that can be recognized by ARToolkit are only markers with a black frame pattern in them, so this program uses a marker pattern with the standard provisions. In ARToolkit, a folder has been provided that contains standard markers that can be used. The folder is called Patterns which is stored on the hard disk. Blank.patt is also available here, which is an empty pattern provided so that developers can create their own patterns. The results of the markers that have been created previously in the marker creation step are as follows:

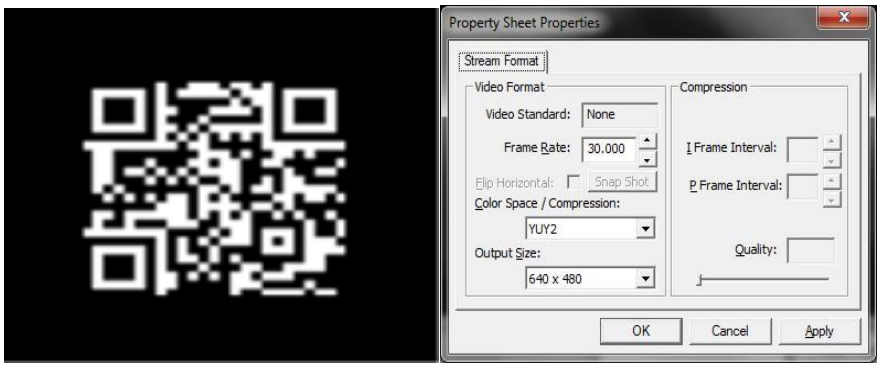

Figure 5, Contoh perancangan marker

Next, after the marker is formed, the marker detection setup is carried out, the steps are as follows:

1. Open mk_patt.exe in the bin folder in ARToolkit.
2. Console worksheet with a display as shown in the following image.

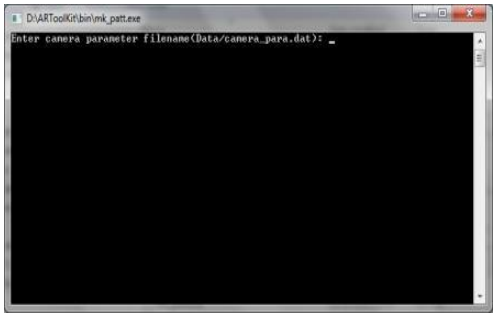

Figure 6, Console *mk_patt.exe*

3. After that, press Enter and a dialog box appears as in the previous image 5.
4. The size can be adjusted to the screen on the computer. But the one that is generally used is 640 x 480.
5. After that, click OK. Then point the marker that has been created to the screen until a green and red box appears around the marker, then click on the edge of the marker until the marker photo is taken.
6. Save the name of the marker created by patt. (marker name). Then this marker is saved by patt.kereta.
7. To see the marker results, simply go to the ARToolkit\bin\ folder then look for the patt. (marker name) file.
8. The next step is to copy-paste the patt that was created into the ARToolkit\Bin\Data\ folder. The marker can now be used in simplevrml.

To run object modeling with ARToolkit software, the object must first be exported to become a .wrl file with the help of 3dMax software. Open 3dMax and the object to be used is in .obj form. In this section the object to be imported is cartdimas.obj.

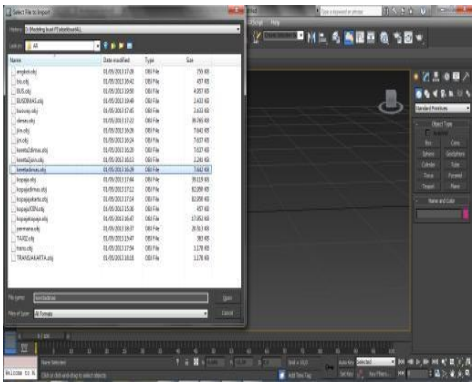

Figure 7, Open the traindimas.obj object.

Place the .wrl export results into the bin\wrl folder in ARToolkit. After the object is saved correctly. Next, copy the previously existing .dat, then rename it to kereta.dat. The wrl folder is where files with the .wrl extension are stored. In this wrl folder there is also a .DAT file which is a place to store the object3D database in the form of Wrl. Open one of the .dat files and open it using Wordpad, rename the old .dat file with the wrl file that will be rendered on the camera later.

Go to the ARToolkit\bin\wrl\data\.. folder and double-click on the object_data_vrml file. From object_data_vrml there will be a new database, this database functions to read wrl files that have been inserted in the .dat file. In addition, this database also functions to read markers that you want to render on the camera. Enter the name of the object.dat and replace it with the marker you want to use for the object. To run, open the simpleVRML.exe file, the camera screen will appear and will render the objects that have been entered into the database and are ready to wait for the highlighted marker. The creation of this Train marker represents the creation of markers on Taxi, Angkot, Kopaja, and Transjakarta because the concept and method of making the four markers are not much different from the process of making this train marker.

To use this Jakarta Transportation Encyclopedia Book, users must first have the ARToolkit software with a directory that has been created. Both three-dimensional object modeling and marker mapping have been done. The software can be downloaded online or on the Playstore. To support the performance of this ARToolkit, users must have a minimum webcam camera specification of 2.0 Megapixels. After ARToolkit is downloaded, click the simpleVRML application on ARToolkit\bin, wait for the rendering process to complete and then highlight the marker located on the book towards the webcam camera on the laptop.

CONCLUTIONS

The formulation of conclusions based on the results of the study is, Making a model of Jakarta's land transportation through the stages of texturing, animating and exporting using 3D Studio Max. ARToolkit software library with marker based tracking method. The markers used are those with a black box frame with a predetermined size, and in the middle of each marker there is a QR-code. This application is useful as a new learning media and introduction to the community, especially early childhood children, to learn more about the means of transportation operating in the Capital area. To provide sound effects from each model, a sound marker is made that is not integrated with the main object model.

For the development of this encyclopedia to be more interactive and use fewer markers, it is recommended to make it an augmented reality application on an Android-based smartphone.

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