# *Application of Augmented Reality and 3D Animation in School Promotion Media*

Penerapan Augmented Reality dan Animasi 3D pada Media Promosi Sekolah

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*Abstract* — **Kalasey Development Agricultural State Vocational High School is located in Kalasey Satu, Mandolang District, Minahasa Regency, North Sulawesi Province, currently still uses printed media as a school promotion media. However, there are limitations of printed media in describing the school environment and facilities in detail due to visualization that is limited to text and images, so media that can provide information in a more interactive and detailed manner is needed. Through the advancement of multimedia technology, such as augmented reality and 3D animation, these two technologies can be utilized to complete detailed information that has not been included in school promotional media. The purpose of this research is to produce augmented reality and 3D animation applications that will be used as school promotional media to the public. This research uses the Multimedia Development Life Cycle (MDLC) method which consists of 6 stages and marker based tracking method to detect marker. Based on the results and testing conducted, the conclusion is that augmented reality and 3D animation can be used as a school promotional media in introducing school facilities and infrastructure and to provide a real picture of the school environment that is easy to understand by prospective new students.**

*Key words*— **3D Animation; Augmented Reality; Marker Based Tracking; School Promotion Media**

*Abstrak* — **SMK Negeri Pertanian Pembangunan Kalasey, yang terletak di Kalasey Satu, Kec. Mandolang, Kab. Minahasa, Provinsi Sulawesi Utara, saat ini masih menggunakan media cetak sebagai media promosi sekolah. Namun adanya keterbatasan media cetak dalam menggambarkan lingkungan dan fasilitas sekolah secara detail karena visualisasi yang terbatas pada teks dan gambar, sehingga diperlukan media yang dapat memberikan informasi secara lebih interaktif dan mendetail. Melalui kemajuan teknologi multimedia, seperti augmented reality dan animasi 3D, kedua teknologi ini dapat dimanfaatkan untuk melengkapi informasi detail yang belum termuat pada media promosi sekolah. Tujuan penelitian ini adalah menghasilkan aplikasi *augmented reality* dan animasi 3D yang akan digunakan sebagai media promosi sekolah kepada publik. Penelitian ini menggunakan metode Multimedia Development Life Cycle (MDLC) yang terdiri dari 6 tahap dan metode *marker based tracking* untuk mendeteksi marker. Berdasarkan hasil dan pengujian yang dilakukan, didapatkan kesimpulan yaitu *augmented reality* dan animasi 3D dapat digunakan sebagai media promosi sekolah dalam memperkenalkan sarana dan prasarana sekolah serta untuk memberikan gambaran nyata lingkungan sekolah yang mudah untuk dimengerti oleh calon siswa baru.**

*Kata kunci* — **Augmented Reality; Animasi 3D; Marker Based Tracking; Media Promosi Sekolah**

## I. INTRODUCTION

Augmented reality and 3D animation are the impact of technological developments in the multimedia world that have been utilized by various fields as promotional media, learning media, entertainment media and others. 3D animation is one of the forms of animation, which manipulates 3D objects to produce a series of images that when put together will give the illusion of motion [1]. The advantage of 3D animation is the visualization of objects that look real and close to their original form [2]. While augmented reality is a technology that can combine the real world with the virtual world in 3D and is interactive in real time [3]. The advantage of augmented reality is that it can be used to help visualize abstract concepts for understanding and structure of an object [4].

SMK Pertanian Pembangunan Negeri Kalasey is an agricultural school located in Minahasa district, North Sulawesi. In promoting the school, SMK Pertanian Pembangunan Negeri Kalasey still uses flyer media, banners and verbally to the community. In the flyer media, not all school information can be included because it is limited and there are only a few pictures of school facilities that can be included. In addition, the school pictures on the flyer are also less able to provide a real picture of the school environment because it cannot show the entire school area.

In today's digital marketing era, promotion using traditional media such as brochures, pamphlets, banners and others, is considered less effective for promoting a good or service that requires detailed information. This is because printed media is only limited to writing or text even though there is support in the form of images or photos but because the visualization displayed is limited, potential buyers are less able to understand the contents of the media [5]. So that media are needed that can assist in providing detailed information. Augmented reality can be used in print promotional media to add information that aims to complement important information that has not been included in print media [6].

Therefore, augmented reality and 3D animation videos can be used as promotional media because they can help visualize certain objects into 3D form, so that they can complement each other with more detailed information.

## A. Related Research

Research conducted by Merry Sangari in Lalumpe village in 2022 using the MDLC method, resulted in an augmented reality application that displays tourist attractions in the Lalumpe village in 3D as a promotional medium. [7]

Research conducted by Reza Andrea at SMPIT Cordova Samarinda using the MDLC method, producing an Android application that focuses on displaying 3D school buildings and 3D school facilities. Focuses on displaying 3D school buildings and 3D school facilities, namely library, computer lab, language lab and science lab as promotional media [8].

Research conducted by Markho Maramis at Sam Ratulangi University using the MDLC method, produced a 3D video of the fatek building which was displayed using the Layar application for augmented reality on brochures as an introductory media. [9].

Research conducted by Karmila Sari at SMK Negeri 1 Polewali produced an android application that uses augmented reality to display school buildings in 3D as promotional media [10]

Research conducted by Hendri Syahputra at Gajah Putih Takegon University, using the MDLC method with the final result of an animation of the engineering faculty profile of Gajah Putih Takegon University in video format [11].

Research conducted by Baihaqi at Serambi Mekkah University uses pre-production, production and post-production methods in making animations with the theme of fatek serambih mekkah profile which aims to promote the facilities provided. [12].

Research conducted by Marfil Rompas at Sam Ratulangi University used tracking camera techniques and pre-production, production and post-production methods in designing animation of the UNSRAT engineering faculty building as a promotional medium with the final result in the form of a short film [13].

Research conducted by Rahman Syahputra in the governor's office of Bengkulu province, using the MDLC method and the final result of animation that focuses on the layout of the building with video format. [14].

## B. Kalasey State Vocational School for Agriculture Development

Kalasey State Vocational School for Agriculture Development is an agricultural vocational school located in Kalasey Satu, Mandolang sub-district, Minahasa district, North Sulawesi province. SMK PPN Kalasey has A accreditation and the title of SMK Center of Excellence given by the Ministry of Education and Culture to 11 schools in North Sulawesi in 2021 [15]. The school, with a land area of 90,000 $m^2$, was established on July 28, 2010 and has 3 Expertise Programs, namely Crop Agribusiness, Livestock Agribusiness and Agricultural Product Processing Agritechnology.

## C. Augmented Reality

Augmented reality is a technology that combines virtual objects into the real world and then displays them in real time with the help of special devices such as smartphones, special glasses and others. This technology is able to lift an object that was previously flat or two-dimensional, as if it became real, united with the surrounding environment [16]. Augmented reality can be used to help visualize an abstract concept so that users can understand the information more clearly.

## D. Marker based tracking

Marker-based tracking is a method that uses 2-dimensional markers or markers that have special patterns and can be detected by the camera as a trigger for the appearance of virtual objects. Markers are usually square-shaped consisting of borders and patterns in the middle that are black and white background. But in its development, markers do not have to be black and white but can use colored markers to display 3D objects [17].

## E. Multimedia

Etymologically, multimedia comes from the word multi which means many or more than one and media which means container, intermediary or introduction. According to Vughan in the book Introduction to Multimedia Systems, multimedia is a combination of art, text, images, sound, video and animation delivered by computers or manipulated digitally and can be controlled interactively [18].

## F. Animation

Animation is a series of still objects that are specially arranged so that they move according to a predetermined flow at each count of time [18]. There are several types of animation that have their own characteristics. First, there is cell animation, which is the first type of animation, consisting of a series of images drawn by hand, then sequenced and played so that the object appears to move.

Then, there is stop motion animation, which uses objects usually made of clay. Each movement of the object is captured and recorded in a single frame, then arranged sequentially to create movement. Next, 2D animation, known as flat animation, involves objects moving in two dimensions, with the viewpoint limited to the X and Y axes, and the animation process is assisted by a computer.

Finally, there is 3D animation which is a development of 2D animation where the animated object has a three-dimensional viewpoint, namely X, Y and Z, making the object look more real. Each object's movement is organized into frames and then a collection of frames are arranged sequentially and played to create an object that appears to move.

## G. Flyer

Flyers are promotional media consisting of one sheet of paper with the commonly used sizes of A4, A5 and A6, and are usually printed on one or two sides. But along with its development, flyers are now not only in the form of printed media but have switched to digital media that is widely spread on social media and the internet. Flyers are often used as advertising media and introduce products and services [19].

## H. Android

Android is an operating system for Linux-based mobile devices that includes an operating system, middleware and

applications. Android provides an open platform for developers to create their own applications [20].

### I. UML (Unified Modelling Language)

UML is a method of visual modeling that is used as a means of designing object-oriented systems or commonly known as a standard language for writing blueprints for software [21]

## II. RESEARCH METHODS

### A. Thinking Framework

The flow of the research process carried out in this study is described through the framework in figure 1.

### B. Time and Place of Research

This research was located at Kalasey Development Agricultural State Vocational High School is located in Kalasey Satu, Mandolang District, Minahasa Regency, North Sulawesi Province. With the research time starting from February 2023 until completion.

### C. Development Method

Multimedia development uses the Multimedia Development Life Cycle method which consists of 6 stages including concept, design, material collecting, assembly, testing and distribution. These stages can be seen in figure 2.

1) Concept

The concept stage is the stage to determine the purpose, target users, and type of application.

2) Design

The design stage is the stage where the architecture, style, appearance and material requirements of the application program are determined. This step involves creating use case diagrams and activity diagrams.

3) Material collecting

Material collecting is the stage where materials such as data, videos, images and audio are collected in digital formats that suit the needs. All materials collected at this stage will be used in the assembly stage.

4) Assembly

Assembly is the production stage of all 3D objects, based on the flowchart and storyboard created during the design stage.
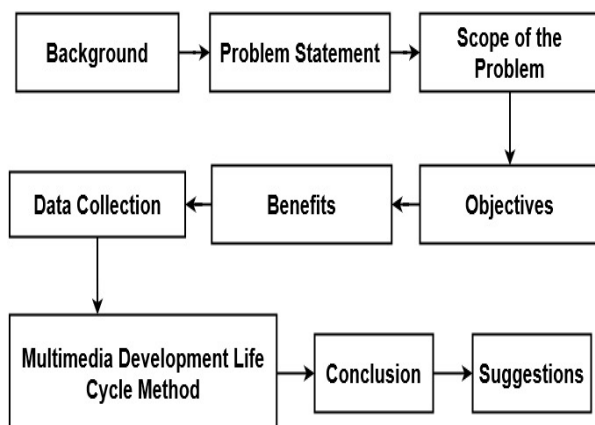
The applications to be used are 3D blender for 3D object design and 3D animation, unity 3D application to integrate objects with markers, and Vuforia application as a database for markers of 3D objects to be displayed

5) Testing

Testing is a testing stage to find out whether the application that has been made is according to plan or not.

6) Distribution

Distribution is the stage where the application is stored in a storage medium after which it will be distributed to end users.

## III. RESULTS AND DISCUSSION

### A. Concept

At this stage, the concept of the application to be made will be determined such as the purpose of making the application, the target or target user of the application and the type of application.

The application built will be android-based with prospective new students as its target users. The main purpose of this application is to promote Kalasey State Vocational School for Agriculture Development to the public. This application will utilize Augmented Reality (AR) technology with marker based tracking method where application users can see animated videos and interactive 3D objects through school promotional media, namely flyers.

In the animation video, the animation principles that will be applied are the principle of animation staging for setting the angle of shooting, slow in slow out for vehicles running around the school and agricultural machinery on the farm, Arc and secondary action for human and animal movements and slow in for water flow movements. In addition, the animation video will use camera tracking techniques to show the entire school area in $360^0$ where there are school facilities and infrastructure to provide an overview of the school environment to the public.

### B. Design

This stage includes designing application requirements such as use case diagrams and activity diagrams which aim to make the application can be built in accordance with the design that has been decided.
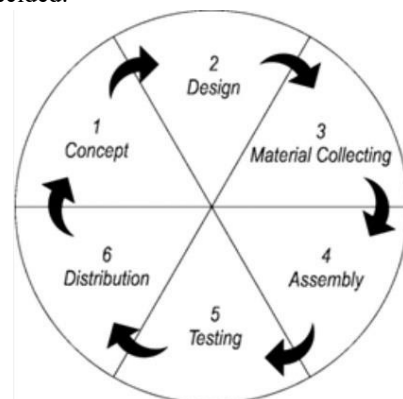

Figure 1. Thinking Framework


Figure 2. Multimedia Development Life Cycle (MDLC)

Use case diagram is a diagram that shows the interaction between users and the system using certain symbols to clarify the flow of interaction. While Activity diagram is a diagram used to model the process or workflow that occurs in a system.

*C. Material Collecting*

At this stage, the materials needed in the process of making 3D animation applications and videos are collected. These materials include buttons, images, audio, text and 3D objects that already exist or can be modified as needed (see table I).
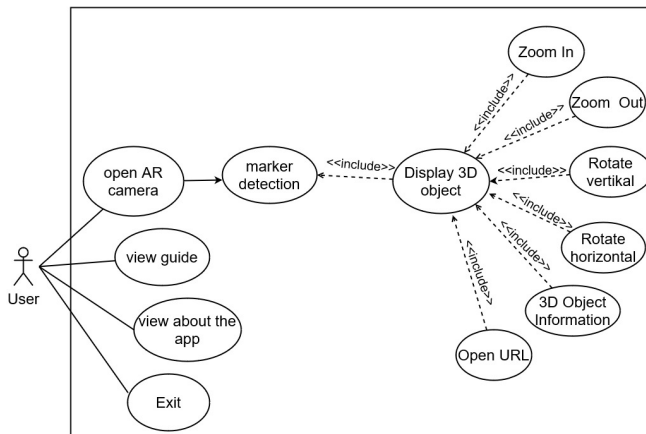


Figure 3. Use Case Diagram
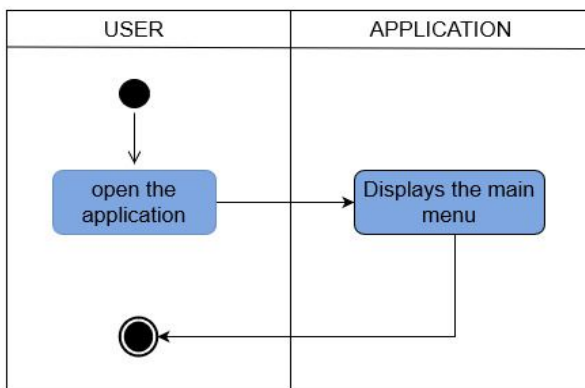


Figure 4. Activity Diagram Main Menu
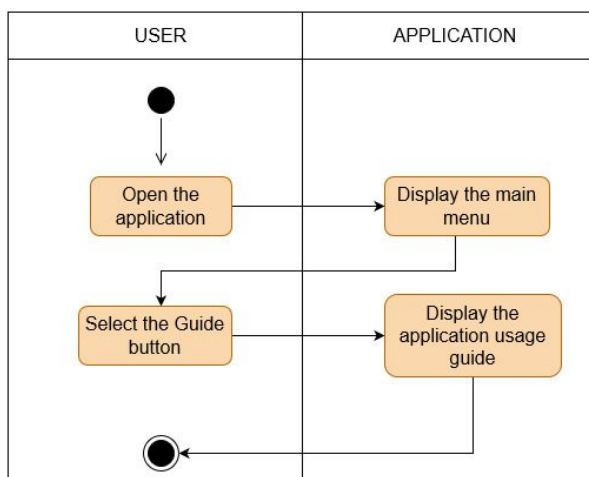


Figure 5. Activity Diagram Application Guidelines Menu
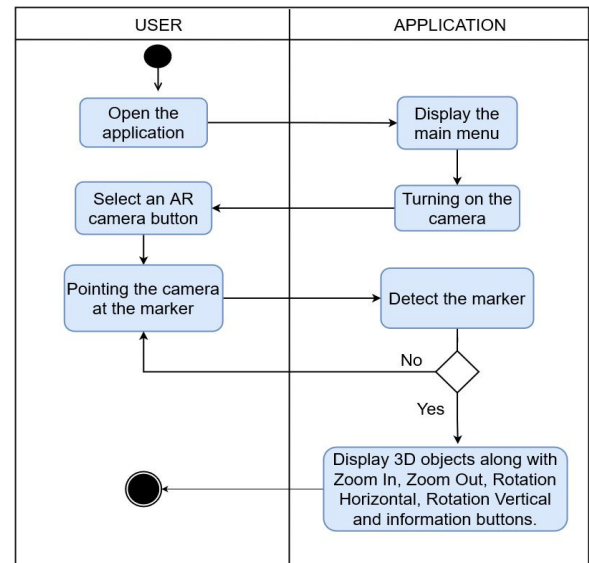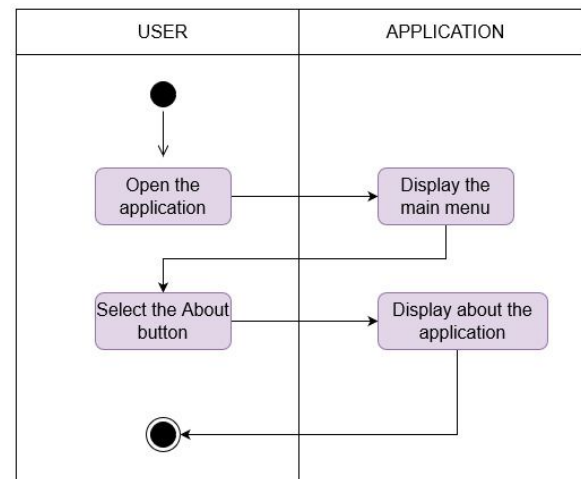


Figure 6. Activity Diagram AR camera



Figure 7. Activity Diagram About Menu

TABLE I.
MATERIAL COLLECTING

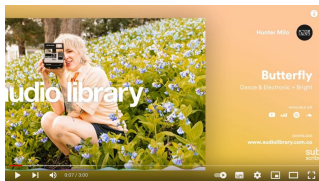| No. | Material | Description |
| --- | --- | --- |
| 1. |  | A collection of icons that are used as buttons in the application. Created using figma application |
| 2. |  | A collection of images used as markers on school flyers. Created using figma application |

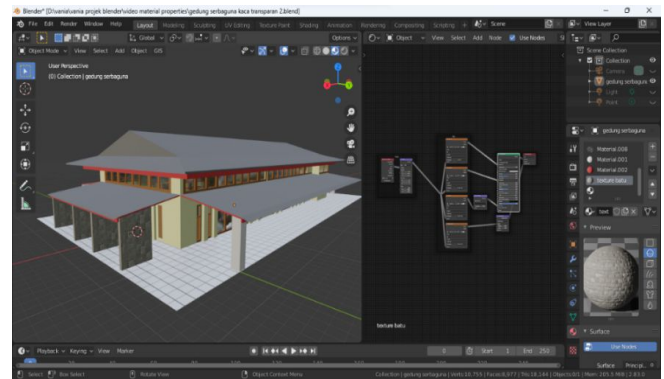| 3. | | Background main menu |
| 4. | | Background description panels in the app |
| 5. | | Backsound used in the animation video |



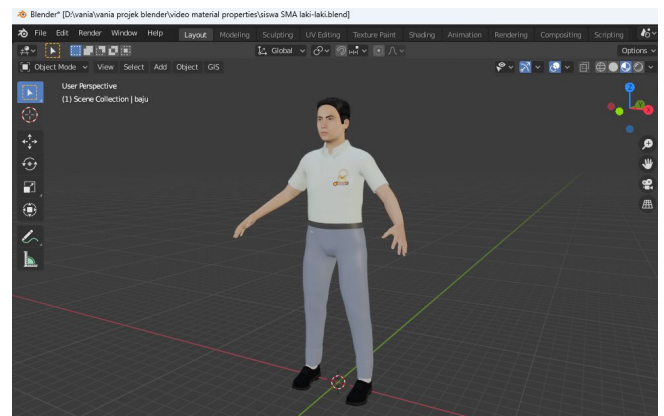Figure 8.  3D object generation



Figure 9.  Human Character Generation

## D. Assembly

This manufacturing stage is carried out making animated videos and applications in accordance with the design that has been made at the design stage.

### 1) 3D object generation

The animation video created will be 3D-based. Creating 3D school facilities and environment objects using Blender application. Starting from object modeling to giving color and texture following objects in the real world so that it looks more realistic. (see figure 8)

Human characters are created using the MakeHuman application, where the human characters created have been adjusted to the body proportions of average students and teachers.

Then the human characters that have been made are modified in the Blender application to be given uniforms as needed. (see figure 9)

### 2) Animation making

The creation of human, animal, water and vehicle animations is done using the Blender application. Where for human and animal characters are given rigging to adjust the movement of objects as needed (see figure 10). Each animated object, the movement is set using a path so that the object can walk according to the specified path with the speed that has been set in the frame using keyframes (see figure 11).

Then the animation that has been created, rendered and exported into video format, namely mp4.

### 3) Creation of animation video

The creation of the animation video is built using the capcut application, where each scene that has been rendered into a video in the Blender application, is put together in the order that has been arranged in the storyboard. A collection of videos that have been arranged as needed in the capcut application, then exported into mp4 format so that it becomes a complete animated video. (see figure 12)

### 4) Application development

The augmented reality application was built using the Unity application. Starting with the creation of the main menu scene, which is the first interface that will appear when the user opens the application, where there are AR camera menus, guides and about the application (see figure 13).

Creating an AR camera scene is a menu to display 3D objects and animated videos through marker detection. Each 3D object is then positioned above the marker and each object has its own marker.

On the 3D school facility marker, there are zoom in, zoom out, horizontal rotation, vertical rotation and info buttons to control 3D objects (see figure 14).

To reduce the size of the application, the 3D animation video will be uploaded to Youtube and will be accessed via a direct link. Where the link will be saved into a button so that when the user chooses the button, the user will be directly diverted to Youtube (see figure 15).

Create a guide scene that has a panel containing a description of the application usage guide and a back button to return to the main menu (see figure 16).

Create a scene about the application that has a description panel about the developer and application (see figure 17).

After setting each game object, then create a script that will manage the functions of each scene such as switching scenes and running buttons.
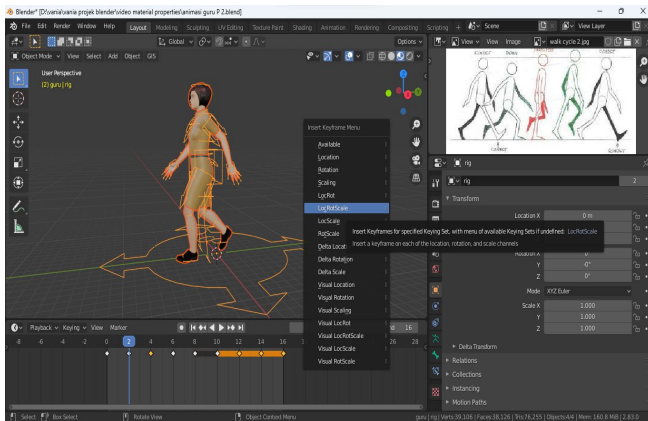
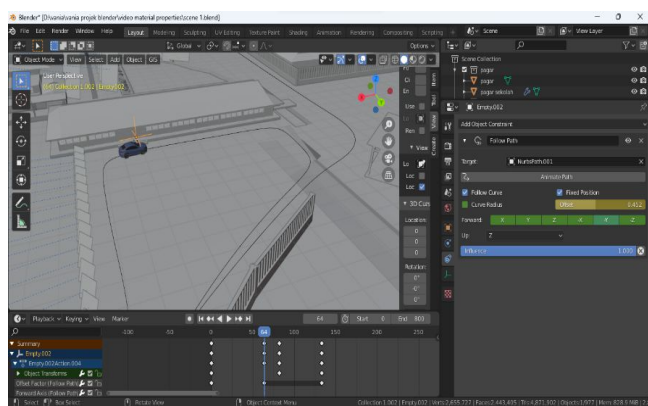Figure 10.  Animation Creation of 3D Human Characters
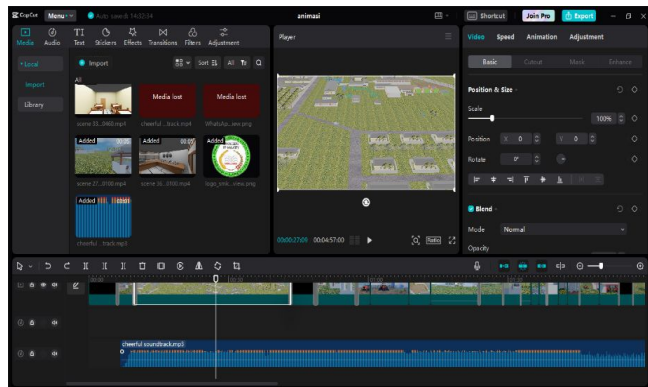


Figure 14.  Button Control for the 3D object



Figure 11.  Assigning a Path to the Animated Object
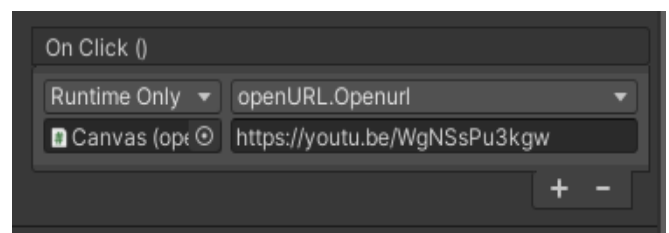


Figure 15.  3D animation video link saved into a button



Figure 12.  Editing Process of Animation Video
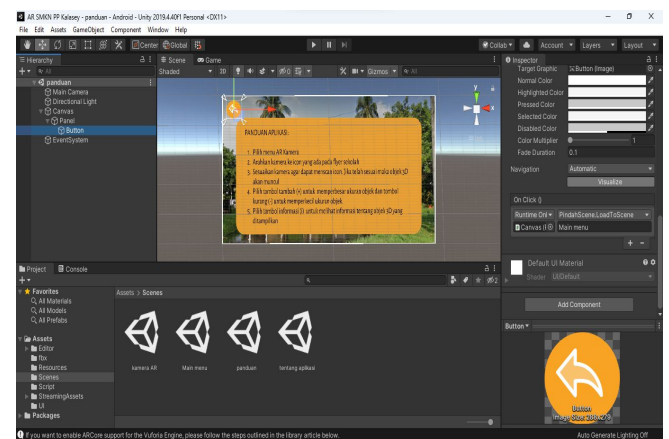


Figure 16.  Creation of Application Guide Menu
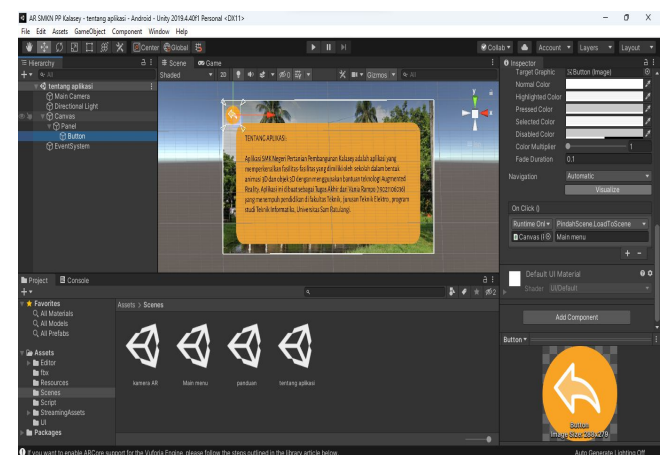


Figure 13.  Creation of Main Menu



Figure 17.  Creation of About Application Menu

## E. Testing

After the application is completed, the next step is the testing stage. In the testing stage, there is an alpha testing and beta testing process.

### 1) Alpha testing

Alpha testing is a testing process carried out by application developers to ensure that the application has run as desired. The testing process carried out is testing the appearance of the application and the function of each application feature.

Table II is the result of testing all features carried out on the main menu (see table II). Table III is a test of all features carried out on the AR camera menu (see table III). Table IV is a test of all features carried out on the guide menu (see table IV) and table V is a test of all features carried out on the menu about the application (see table V). Where the final results of alpha testing show that all features in the application can run well.

### 2) Beta Testing

Beta testing is a testing process carried out by application users, namely prospective new students. This process aims to get user feedback and experience when using the application. Testing was carried out by giving the application to 30 prospective new students at the Kalasey Development Agricultural State Vocational High School. Where after testing the application, prospective new students are given a questionnaire containing questions about user responses and experiences after using the application.

The first question shows the results of using augmented reality technology in introducing the school (see figure 18). The second question shows the result of applying 3D animation video in introducing the school (see figure 19). The third question shows the results of how well the application helps users know the facilities owned by the school (see figure 20). The fourth question shows the results of how well the application uses the school location feature (see figure 21).

The fifth question shows the results of the application of 3D animation videos in introducing schools in real life (see figure 22). The sixth question shows the results of how well the application helps users know the focus of the field studied by each department (see figure 23). The seventh question shows the results of how many agree that with this application users can find out the facilities owned by each department (see figure 24). The eighth question shows the results of how attractive the application looks (see figure 25). The ninth question shows the results of the information in the application can be more easily understood (see figure 26). The tenth question shows the results of the level of ease of use of the application (see figure 27). The eleventh question shows the result of the user's opinion of the application (see figure 28). The twelfth question shows the results of the level of usefulness of the application for users (see figure 29).

TABLE II.
TESTING THE MAIN MENU

| No | Feature tested | Test process | Expected result | Test result |
|---|---|---|---|---|
| 1. | Camera AR button | Users press the AR camera button | Enabling the vuforia camera | Success |
| 2. | Guide button | Users press the guide button | Displays the guide page | Success |
| 3. | About button | Users press the about button | Displays the about page | Success |
| 4. | Exit button | Users press the exit button | Exit the application | Success |

TABLE III.
TESTING THE CAMERA AR MENU

| No. | Feature tested | Test process | Expected result | Test result |
|---|---|---|---|---|
| 1. | Zoom in button | Users press the AR zoom in button | Scale up the size of 3D school facilities | Success |
| 2. | Zoom out button | Users press the zoom out button | Scale down the size of 3D school facilities | Success |
| 3. | Rotate button | Users press the rotate button | Rotate the 3D school facilities horizontally | Success |
| 4. | Information button | Users press the information button | Display an information panel about the displayed object | Success |
| 5. | Play button | Users press the play button | Start the 3D animation video | Success |
| 6. | Pause button | Users press the pause button | Pause the 3D animation video | Success |
| 7. | Stop button | Users press the stop button | Stop the 3D animation video | Success |
| 8. | The school location button | Users press the school location button | Redirect users to the school location on maps | Success |
| 9. | The school Facebook button | Users press the school Facebook button | Redirect users to school Facebook account | Success |
| 10. | The school Instagram button | Users press the school Instagram button | Redirect users to school Instagram account | Success |

| 11. | The school Youtube button | Users press the school Youtube button | Redirect users to school Youtube account | Success |
| 12. | Next button | Users press the next button | Displays the next figure | Success |
| 13. | Previous button | Users press the previous button | Displays the previous figure | Success |
| 14. | Home button | Users press the home button | Back to the main menu | Success |

TABLE IV.
TESTING THE GUIDANCE MENU

| No. | Feature tested | Test process | Expected result | Test result |
| --- | --- | --- | --- | --- |
| 1. | Home button | Users press the home button | Back to the main menu | Success |

TABLE V.
TESTING THE ABOUT MENU

| No. | Feature tested | Test process | Expected result | Test result |
| --- | --- | --- | --- | --- |
| 1. | Home button | Users press the home button | Back to the main menu | Success |

Augmented Reality adalah teknologi yang digunakan untuk menampilkan objek 3 dimensi pada layar melalui deteksi gambar. Menurut anda bagaimana penggunaan teknologi Augmented Reality dalam memperkenalkan sekolah?

30 jawaban



- Sangat buruk
- Buruk
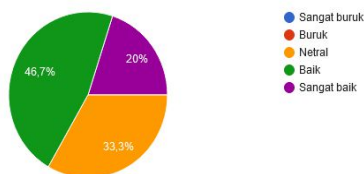- Netral
- Baik
- Sangat baik

Figure 18. Percentage of answers to the first question questionnaire

Menurut anda bagaimana penerapan video animasi 3D dalam memperkenalkan sekolah?

30 jawaban



- Sangat buruk
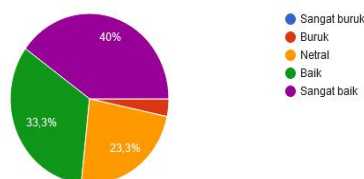- Buruk
- Netral
- Baik
- Sangat baik

Figure 19. Percentage of answers to the second question questionnaire

Apakah informasi yang diberikan dapat membantu anda mengetahui fasilitas unggulan yang dimiliki oleh sekolah?

30 jawaban



- Sangat tidak membantu
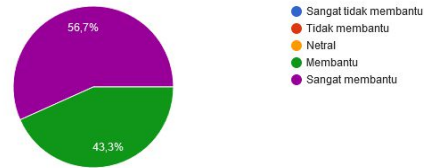- Tidak membantu
- Netral
- Membantu
- Sangat membantu

Figure 20. Percentage of answers to the third question questionnaire

Menurut Anda, apakah anda setuju jika informasi lokasi sekolah yang ditampilkan menggunakan augmented reality dapat membantu anda mengetahui lokasi sekolah dengan mudah?

30 jawaban



- Sangat tidak setuju
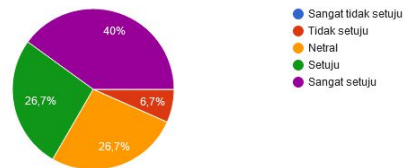- Tidak setuju
- Netral
- Setuju
- Sangat setuju

Figure 21. Percentage of answers to the fourth question questionnaire

Menurut anda, apakah anda setuju jika lingkungan sekolah yang digambarkan melalui video animasi 3D dapat memberikan anda gambaran lingkungan sekolah secara nyata?

30 jawaban



- Sangat tidak setuju
- Tidak setuju
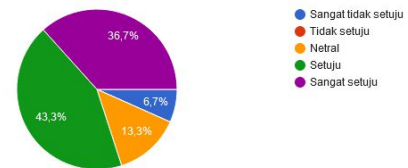- Netral
- Setuju
- Sangat setuju

Figure 22. Percentage of answers to the fifth question questionnaire

Apakah informasi program kejuruan yang ditampilkan dalam bentuk video animasi 3D dan melalui Augmented Reality dapat membantu anda lebih memahami fokus bidang yang dipelajari oleh tiap jurusan?

30 jawaban



- Sangat tidak membantu
- Tidak membantu
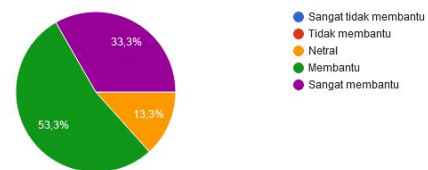- Netral
- Membantu
- Sangat membantu

Figure 23. Percentage of answers to the sixth question questionnaire

Menurut anda, apakah anda setuju jika adanya aplikasi ini dapat membantu anda mengetahui fasilitas-fasilitas yang dimiliki oleh setiap jurusan?
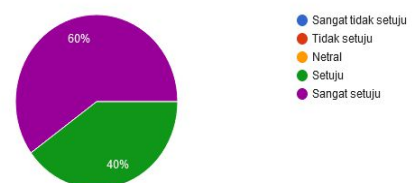
30 jawaban



- Sangat tidak setuju
- Tidak setuju
- Netral
- Setuju
- Sangat setuju

Figure 24. Percentage of answers to the seventh question questionnaire

Apakah aplikasi ini memiliki tampilan yang menarik?
30 jawaban



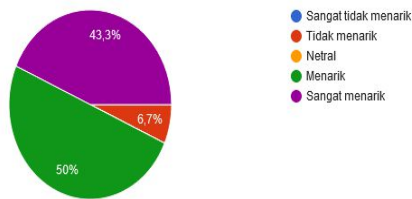- Sangat tidak menarik
- Tidak menarik
- Netral
- Menarik
- Sangat menarik
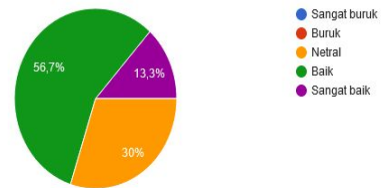
Figure 25. Percentage of answers to the eighth question questionnaire

Menurut Anda, apakah informasi yang disajikan menggunakan aplikasi lebih mudah dipahami dibandingkan hanya dalam bentuk teks dan gambar?
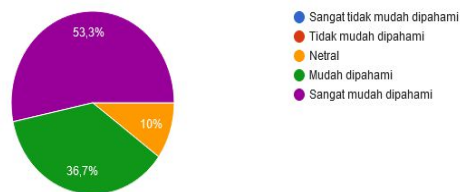30 jawaban



- Sangat tidak mudah dipahami
- Tidak mudah dipahami
- Netral
- Mudah dipahami
- Sangat mudah dipahami
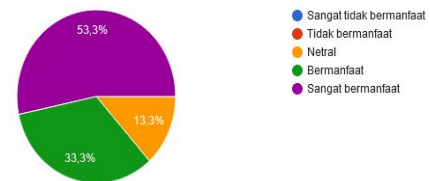
Figure 26. Percentage of answers to the ninth question questionnaire

Menurut anda apakah aplikasi ini mudah untuk digunakan?
30 jawaban



- Sangat tidak mudah
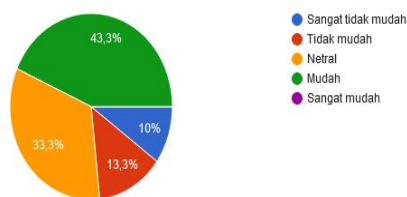- Tidak mudah
- Netral
- Mudah
- Sangat mudah

Figure 27. Percentage of answers to the tenth question questionnaire

Based on the results of beta testing that has been done to 30 respondents, the results show that augmented reality can promote schools by displaying the real school environment in the form of 3D animation, introducing superior facilities and facilities owned by each vocational program and introducing vocational programs owned, the vision and mission of the school, school social media and school locations in 3D so that it can provide a real picture of the school and is more easily understood by prospective new students.

### F. Distribution

The distribution stage is the last stage in the MDLC method, where the finished application is distributed to end users. The application that has been made in .APK format is then saved to google drive storage media and distributed using a link to users.

Bagaimana pendapat anda tentang keseluruhan aplikasi ini?
30 jawaban



- Sangat buruk
- Buruk
- Netral
- Baik
- Sangat baik

Figure 28. Percentage of answers to the eleventh question questionnaire

Apakah aplikasi ini bermanfaat bagi pengguna?
30 jawaban



- Sangat tidak bermanfaat
- Tidak bermanfaat
- Netral
- Bermanfaat
- Sangat bermanfaat

Figure 29. Percentage of answers to the twelfth question questionnaire

## IV. CONCLUSIONS AND SUGGESTIONS

### A. Conclusion

Based on the results of the research that has been done, it can be concluded that augmented reality applications and 3D animation have been successfully created using the Multimedia Development Life Cycle application development method. Making human characters is made using the MakeHuman application, while making 3D objects and animations is made using the Blender application, and for augmented reality applications built using the Unity 3D application. The augmented reality application can be used as a school promotion media because it can introduce the school well where based on the questionnaire results obtained as many as 43.3% of prospective students agree, 36.7% of prospective students strongly agree, 13.3% of prospective students are neutral and 6.7% of prospective students strongly disagree that the existence of augmented reality applications and 3D animation videos can provide a real picture of the school environment and as many as 53.3% of prospective new students choose very easy to understand, 36.7% of prospective new students choose easy to understand, 10% of prospective new students choose neutral that the information presented using the application is easier to understand than only in the form of text and images. After testing the application, it can be concluded that the application of augmented reality and 3D animation in school promotional media can help prospective students in getting to know the school environment and knowing the school's superior facilities, and prospective students find it easier to understand information using the application than just text and images.

*B. Suggestion*

    This application can currently only be run on the android platform, so it is hoped that in further research this application can be developed again so that it can run on other platforms and can be enjoyed by other smartphone users. Then for further 3D animation development it is better to use a computer with high specifications so that the animation production process can be more efficient and save processing time.

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