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DEVELOPMENT OF ARTS LEARNING MEDIA USING AUGMENTED REALITY WITH MARKERLESS BASED TRACKING METHOD AT SMKN 47

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Abstract – During the transitional time between Covid-19 and endemic, all Indonesian schools, and SMKN 47 in particular, had restricted educational opportunities. Due to challenges encountered by the instructor and 36 students majoring in accounting in grade 12, they were unable to carry out teaching and learning activities at school; art lesson formats with three-dimensional learning modules must be visualized in 3D. However, with hybrid teaching and learning utilizing presentations, displaying the learned 3D forms is less successful. In order to visualize three dimensions in fine arts classes using augmented reality technology, we require a new learning medium. The application of the Markerless Based Tracking approach in this work enables the presentation of a tracked 3D model in the surrounding environment in real-time by merging the actual and virtual worlds as if their boundaries did not exist. The augmented reality system scans flat surfaces utilizing points, as opposed to markers or other auxiliary media. Points used as pedestals or containers to elevate three-dimensional items. There are three sculptures and three traditional dwellings on show. Online examination outcomes average resulted a 78.2% that the AR Fine Arts application by instructors and students are therefore consistent and well accepted.

Keywords – Augmented Reality, Arts Learning, Markerless Based Tracking

I. INTRODUCTION

Learning in all Indonesian schools is carried out online based on the decision of the Ministry of Education and Culture of the Republic of Indonesia with Circular Letter Number 4 of 2020 concerning the implementation of education during the Corona virus Disease (COVID-19) emergency period. SMKN 47, including schools in the red zone in the West Pejaten area, South Jakarta, is recommended to carry out teaching and learning activities online due to the pandemic. Based on interviews conducted with fine arts teachers at SMKN 47, 90% of the 36 grade 12 students majoring in accounting had difficulty understanding fine arts lessons, because the learning activity method was less interesting and difficult for students to understand. Therefore, we need a new visualization learning media to help teachers and students create interesting visualizations in teaching and learning even if they don't visit museums or galleries during this pandemic [1],[2].

In this research, the SMKN 47 school conducted online teaching and learning in accordance with the provisions of the Ministry of Education and Culture of the Republic of Indonesia, fine arts lessons are one of the lessons that require visualization aids in online fine arts subjects[3], [4],[5], because of the limited physical teaching aids which make teaching and learning activities ineffective, because during this pandemic Augmented Reality visualization can help in teaching and learning at SMKN 47 To overcome these problems, solutions are needed for teachers and students in the online learning process using Augmented Reality [6],[7]. With the help of Augmented Reality, teachers can convey lessons to students more easily because of the new visualizations that will be provided, and students will understand better and not feel bored during class time [8]. Augmented Reality is a combination of the real world and the virtual world where the boundary between the two seems to be non-existent. The aim of Augmented Reality is to combine virtual and reality objects into one scope to interact with each other [9],[10].

The method used to overcome this problem is markerless based tracking with the help of the Vuforia SDK. The implementation in this research is to display 3D objects in the real world without using markers using real-time processing[11],[12]. The advantage of markerless based is that it only requires a flat surface such as a floor or table to scan to display an object. Previous research that also discussed markerless tracking was research from [13] where the research carried out was to utilize markerless tracking to learn about installing car engine spare parts where the results of this research stated that the use of markerless tracking could be used well. Other research conducted by [14] used markerless-tracking in game-based augmented reality applications and building space applications [15].

The results of this research that will be developed here are in the form of visualization learning media for fine arts lessons in the form of an Augmented Reality application with a total of 6 objects, namely 3 sculptures and 3 traditional houses using markerless based tracking to overcome problems in visualizing three-dimensional fine arts by utilizing Augmented Reality at SMKN 47 school using the markerless based tracking method.

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II. RESEARCH METHODOLOGY

markerless based tracking is one method Augmented Reality which does not require special knowledge about the environment for the user to display virtual objects at a certain point[16], [17]. Camera onsmartphone will scan the surface to collect visual data from the real world, when you want to display a 3D model, it will process the scan without a special marker, the 3D model will be taken from the processmapping by taking data fromupdate, and scan the position of the 3D model on the floor to display the 3D model on the screensmartphone[18],[19].

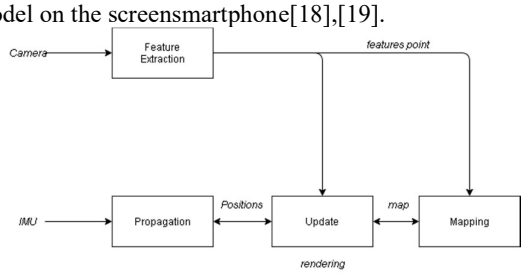

Figure 1. FlowMarkerless Based Tracking

Figure 1 shows the flow of stages in the method processmarkerless based tracking which has four stages, namelyfeature extraction, mapping, update, propagation. The following is an explanation of the stages contained inmarkerless based tracking among others:

Feature Extraction

At this stage what is captured by the camera scans the surface to retrieve data from the real world from the system providing points as a fulcrumsegi curves, edges. After providing points for the basic pattern that will process displaying an object, the system will process creating the object directlyUpdate andMapping perform scanning in unknown environments without using markers or special printing media.

Stages Mapping

In levelmapping, camera captured byfeature extraction will be processed once when looking for points as a fulcrum. If points are detected by the image, it is possible that the 3D model displayed is unstable standing on the surface. Then the feature extraction process will carry out the process again in the same way and match the same points, and in the mapping process it will resemble the shape of the space surrounding the object that has been scanned byfeature extraction.

Propagation

Task onpropagation is ifsmartphone generating a new camera capture position or scanning to another location, will automatically process againupdate andmapping to produce a new position in the form of position data smartphone. IMU is a sensor used to measure three dimensions of an object. The IMU has three gyroscope axes (axespitch, roll, and yaw) and three accelerometer axes (x, y and z axes) which have their respective uses, including gyroscopes for measuring tilt angles, measuring changes in each axis tilt angle and accelerometers for measuring and identifying the correct direction of a smartphone, [20].

Update Stages

Features point that have been detected in the processfeature extraction will be updated by comparingfeatures point which is on the map.Update carried out to improve the mapping and propagation results with the newly detected feature points. Next comes the registration stage which uses tracking to connect virtual content with the real world. This section will continue to process because there will be unstable movement of the gyroscope, therefore this will occur frequently rendering in sectionpositioning ormapping. The process starts from virtual content to the real world, then by finding the best camera angle position, the virtual content will process the image first. Once the image is ready from the system, it will be scanned in this process to see if it has been fulfilled by the system in terms offeature extraction, andmapping. If you can interact with the application and scan with the camerasmartphone, in this pose tracking process the user can interact by moving the camera to see around the 3D model. With the IMU sensor data, the image will be stable because the movement of the pose is not realizedsmartphone unstable when taking pictures of objects that have been scanned on a table or other flat place.

Mechanism Augmented Reality

A. Input

Users run applications that are ready to use on an Android smartphone. After going through the menu display, the user will select the 3D art menu, the application model will immediately switch to the cameraAugmented Reality. Next, the user directs the camerasmartphone to the floor surface until there is a camera indicator mark. In the cameraAugmented Reality, there is a choice of 3D fine art models ranging from traditional houses, and sculptures from various regions, these objects are chosen by the user to display. Next, press the icon button for the desired 3D model to display it in the specified place.

B. Process

On camerasmartphone directed at the floor surface, the system will identify the positionsmartphone with Vuforia SLAM (Egodagamage and Tuceryan, 2018), (Marchand et al., 2016), (Cortes et al., 2018) to display camera indicators, and determine the position of the object you want to display in the real world. By using the methodmarkerless based tracking will process the mechanism or flowmarkerless based tracking in figure 6. After processing the mechanismmarkerless The user scans a flat surface to locate a 3D object. Next, the system will display the appropriate 3D model selected by the user with the specified object placement.

C. Output

The result of the general architecture is a visual art visualization information in the form of a virtual object selected by the user, with the help ofsmartphone The object will display on the screensmartphone. The 3D model displayed on the floor surface is a form of visualization of images that have been processed so that it helps teachers

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and students with teaching aids Augmented Reality desired fine art. The output is provided with the object process that has been directed, the user can process the dimensional shape and rotate the object.

III. RESULTS AND DISCUSSION

The implementation of the interface built for fine art AR applications is as follows:

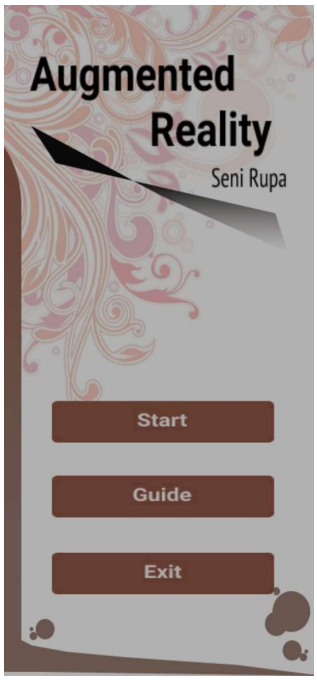

Figure 2. Main Menu Display

Figure 2 shows the main menu display in the AR Senirupa application. In the display above there are 3 button features, namelyStart, Guide, andExit. When entering the AR Camera display, the user must point to a flat surface or floor so that it displays a square or so-calledplane indicator, then the user must select one of the 3d model buttons and be ready to display a 3d art model object.

Guide Feature Display

The guide feature display contains information on how to use the application to display an object and feature function. Here's a lookguide application in Figure 8.

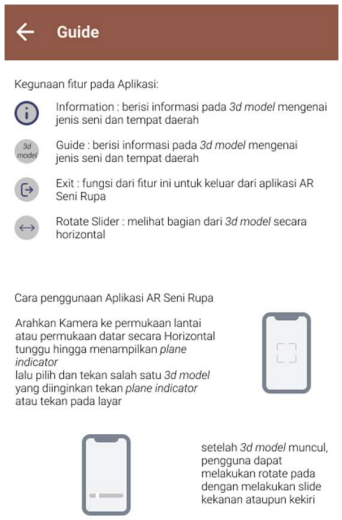

Figure 3. Guide Feature Display

In Figure 3 is a display of the guide feature in the application. The feature guide display explains the meaning of the feature function and how to use the application steps. Featureguide provide information along with pictures.

Display of AR Application Art Objects

Below is an image of the appearance of a 3D object that has implemented markeless-based tracking which can be seen in Figure 4-6:

Figure 4. Toraja House Object

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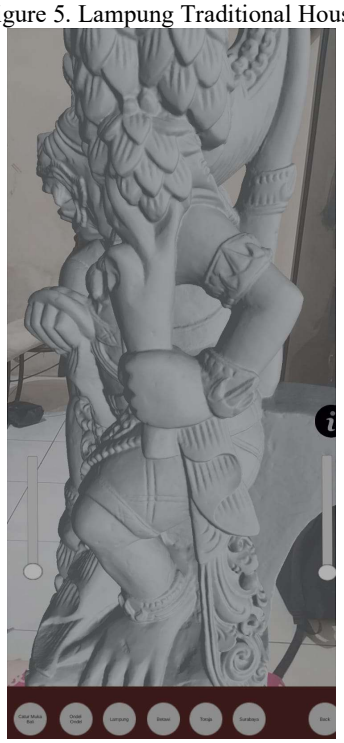
Figure 5. Lampung Traditional House



Picture 6. Catur Muka

Validation Testing

Validation testing was carried out in this research to ensure whether it can be accepted by teachers and students so that learning becomes interactive and increases students' knowledge in fine arts lessons by using Augmented Reality, the demographic profile of the respondents in this study are teachers and students from SMKN 47, where the profiles of the 38 respondents who have been collected are dominated by 17-19 year olds with 36 students and the remaining 2 respondents aged 25-35 with the teaching profession, a total of 38 Respondents consisted of 36 students and 2 teachers.

Online Testing Questionnaire Results

The following is a questionnaire that has been filled in by 70 respondents from AKL 1 (Institutional Accounting and Finance) and BDP 1 (Online Business and Marketing) classes at SMKN 47: Teachers and students experience difficulties during teaching and learning activities with textbooks. The first point to note asked whether teachers and students experienced difficulties during learning activities with textbooks, below in Figure 14 are the percentage results from the first point of the questionnaire.

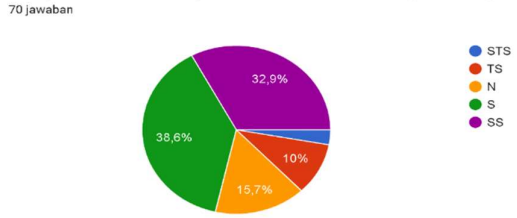


Figure 7. Percentage of results from questionnaire one

Figure 7 shows that 32.9% of 23 respondents strongly agree, 38.6% of 27 respondents agree, 15.7% of 11 respondents are neutral, 10% of 7 respondents disagree and 2.9% of 2 respondents strongly disagree . The average score for the first point is 78%. This result shows that the first score point is that teachers and students accept the first point statement, namely agreeing to the difficulties in teaching and learning with textbooks.

The second point asked whether teachers and students experienced difficulties during online learning activities. Below in Figure 8 are the percentage results from the second point of the questionnaire.

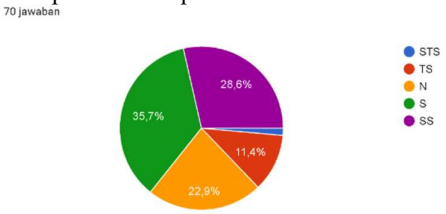


Figure 8. Percentage of second questionnaire results

Figure 8 shows that 28.6% of 20 respondents strongly agree, 35.7% of 25 respondents agree, 22.9% of 16 respondents are neutral, 11.4% of 8 respondents disagree and 1.4% of 1 respondent strongly don't agree. The average score for the second point is 76%. This result shows that the score points for both teachers and students accept the second point statement, namely agreeing with the difficulties in teaching and learning online.

The third point asked whether the AR Fine Arts Application is easy to understand and can operate well, below in Figure 9 is the percentage result of the third point questionnaire.

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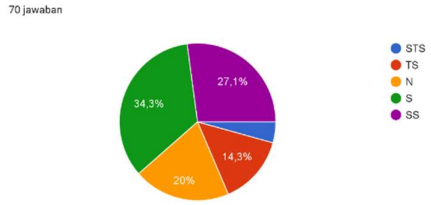

Figure 9. Percentage of third questionnaire results

Figure 9 shows that 27.1% of 19 respondents strongly agree, 34.3% of 24 respondents agree, 20% of 14 respondents are neutral, 14.3% of 10 respondents disagree and 4.3% of 3 respondents strongly disagree . The average score for the third point is 75%. That these results show that the third score point is that teachers and students accept the third point statement, namely agreeing that the AR Fine Arts Application is easy to understand and can operate well.

The fourth point asked whether teachers and students were really helped by the AR fine arts application, below in Figure 10 is the percentage result of the third point of the questionnaire.

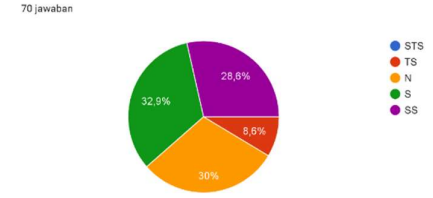

Figure 11. Percentage of results from the fourth questionnaire

Figure 11 shows that 28.6% of 20 respondents strongly agree, 32.9% of 23 respondents agree, 30% of 21 respondents are neutral, and 8.6% of 6 respondents disagree.

The average score for the fourth point is 76%. This result shows that the score of the fourth point is that teachers and students accept the statement on the fourth point, namely that they agree that teachers and students are greatly helped by the AR Fine Arts application.

The fifth point asked whether the AR fine art application could be a new innovation in teaching and learning activities, below in Figure 4.22 is the percentage result of the third point of the questionnaire.

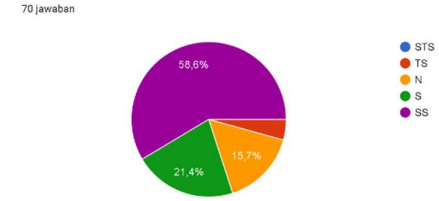

Figure 12. Percentage of Fifth Questionnaire Results

Figure 12 shows that 58.6% of 41 respondents strongly agree, 21.4% of 15 respondents agree, 15.7% of 11 respondents are neutral, and 4.3% of 3 respondents disagree. The average score for the fifth point is 87%.

These results show that the fifth score point is that teachers and students accept the fifth point statement, namely that they strongly agree that the AR Fine Arts Application can be a new innovation in teaching and learning activities. After the average of each point has been obtained, then calculate the average percentage of the total points from user testing. The overall average percentage point calculation is as follows:

Calculation results of the average percentage of overall questionnaire points from testing were 78.2%. So it can be said in the results of the assessment interval that 78.2% of teachers and students agreed and were well received.

IV. CONCLUSION

Based on the results obtained from this research, it can be concluded that the method markerless based tracking was successful in detecting the surface when implemented even though the manufacturing process was still imperfect due to the camera's lack of clarity in searching for surface points to display the object. The results of online testing regarding the AR Fine Art Application produced an average of 78.2%. So it can be said that the results of testing the AR Fine Arts application by teachers and students agreed and were well received.

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