

## Augmented Reality Application with Markerbased Method: Introduction to Android-Based Javanese Script

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**ABSTRACT :** *Javanese script is one of the languages in Indonesia and is a language that must be preserved, many children today do not know the language because too many are introduced to foreign languages. Javanese alphabet is less understood and interested, because the learning system still uses the teacher centered method by placing the teacher as the main element during learning activities without any other learning media besides learning books. Based on these problems, the authors developed the Introduction of Javanese Script Learning Media Application with Augmented Reality technology using Android-based Markerbased method. Augmented Reality is a technology that connects the real world with the virtual world in the form of 3D that is real time. The creation process uses the unity 3D tool by using the Markerbased tracking method, utilizing Vuforia as a database to store markers. The development of the Application of Javanese Script Learning Media Introduction with Augmented Reality technology aims to innovate so that Javanese script learning is more interesting and conducive. Based on the results of research and testing of Learning Media Applications Introduction to Javanese Script with Augmented Reality technology based on android can innovate the way students learn in school and outside of school and increase interest in learning by utilizing technology in this era*

**KEYWORDS:** *Javanese script, Android, Augmented Reality, Markerbased Tracking*

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### I. INTRODUCTION

Javanese Language Subject is a local content that must be taken by elementary school students starting from class I to class VI, there is material in the subject including Javanese Script. Javanese script is a collection of characters used on the island of Java and is often found on street signs, as well as historical relics. Javanese script is considered a form of Indonesian national heritage, but there are problems in the community because not all of them can read Javanese script letters, especially in the younger generation [1]

In grade 4 SD NEGERI JAMBON 2, learning Javanese script material is currently less attractive to students, because it is considered very difficult in terms of pronunciation, form, writing, and memorization. The learning methods used lack innovation, variety, and still use the teacher centered method, which places the teacher as the main element during learning activities. This causes no interaction between teachers, students, and technology. The development of technology is very influential in the aspect of education which has an impact on learning activities [2]. Teachers should be able to implement the use of technology in learning, especially in learning Javanese script which is one of the ancient forms of language in Indonesia.

Based on the description above, researchers designed the Introduction of Javanese Script Learning Media Application based on android using Augmented Reality technology as a basis for learning and Markerbased tracking method as a marker to bring up the character of Javanese Script letters in 3D form. The application contains learning material features that can display several Javanese characters in 3D and contains quiz features that can be used by teachers to encourage learning to be more varied.

### II. THEORETICAL FRAMEWORK

Some of the results of research conducted by previous researchers, which have the same field or theme will be developed. Literature reviews are used by researchers as reference material in their research. The works of the researchers in question are as follows:

This research discusses musical instruments in Indonesia which are divided into two types, namely traditional and modern musical instruments currently, there are still many people who do not know the types of

musical instruments and the lack of facilities to provide visual access to traditional and modern musical instruments. The purpose of this research is to help people to recognize traditional and modern musical instruments in Indonesia through digital technology easily. The method used in this research is the Markerbased Augmented Reality method as a marker or marker for each object to display information in 3D directly[3].

This research paper explores the complex realm of consumer expectations and experiences related to Augmented Reality applications, specifically in the fashion retail sector using a triangulated qualitative approach (through online reviews, focus groups and semi-structured interviews). This research aims to understand the practical and consumer-centered aspects of Augmented Reality applications a neglected area in the field because many studies focus on the technical aspects of Augmented Reality applications[4].

This research discusses an application that has a function as a tool for learning hand limbs in elementary school students by using qualitative methods to collect, analyze primary school student data and Markerbased tracking methods as object markers[5].

This research discusses Augmented Reality, Virtual Reality, and remote-controlled devices to drive the need for better 5G infrastructure. The proposed software will monitor the target images on the printed book, render 3D objects and alphabet models. The app considers the sound (phonetics) and the 3D representation of the letters is played after the target image is detected[6].

### A. Technology Augmented Reality

Augmented Reality (AR) can be explained by pointing to the reality - virtuality continuum which is a possible combination of the real and virtual worlds. In a virtual world, users shape themselves in a completely reconstructed world and users cannot interact with the real world. The understanding of AR is based on enhancing the real world with digital content, combining reality, virtuality, and three-dimensional space[7].

Augmented Reality has a computer-mediated reality or interactive graphics system that allows visualization in images which is crafted by overlapping one or more information layers, whether these are virtual elements, multimedia, or simple data. AR technology provides an information layer supplement in relation to the environment in which the user is operating that is perceived in real-time[8].

Augmented reality aims to develop a technology that enables real-time incorporation of digital content created by computers with the real world so that users or elementary school students can see directly in 3D using smartphones.

### B. Method

Markerbased tracking method is a marker or two-dimensional object marker in the form of an image or barcode that will display a 3D object virtually into the real environment. A marker is a black and white square-shaped illustration with thick black sides and a thick black pattern on a white background. Computers can recognize the position and orientation of markers as well as the formation of 3D objects with points (0,0,0) and three axes x,y, and z. The function of the virtual coordinate point on the marker is to determine the position of the virtual object that will be inserted into the real environment. A marker that successfully recognizes the marker pattern will display the virtual object into the real environment[9].

### C. Types of Android

Android is an operating system for smartphones that includes a Linux-based mobile device system. Android provides several criteria including the Android SDK which houses tools and APIs in applications used by users. Android has several types that are used to support the Augmented Reality platform, including the following:

TABLE 1 Types of Android

Types	Spesifikasi
Android Samsung Galaxy A7	Android 6.0.1 (Marshmallow), upgradable to Android 8.0 (Oreo), Fingerprint (font-Mounted), Accelerometer, Gyro, Proximity, Compass, Barometer.
Android Xiaomi 13 Pro	Android 13, MIUI 14, Fingerprint (optical, below the display surface), accelerometer, light, gyroscope, proximity, compass, color spectrum, barometer.
Android Realme 8 Pro	Android 11 UI 2.0, Ultra-fast In-display Fingerprint Sensor, Light Sensor, Proximity Sensor, Magnetic Induction Sensor, Acceleration Sensor, Gyro-Meter Sensor.

## III. METHODOLOGY

The types of methods used in this research are qualitative and quantitative methods, because this research requires some data that is used as a benchmark for making applications. This research focuses on the introduction of Javanese script letters by utilizing Augmented Reality (AR) technology as a new and innovative technology.

This research was conducted and developed by paying attention to several stages as material for conducting the research process. The following are the stages carried out by researchers in the form of diagrams:

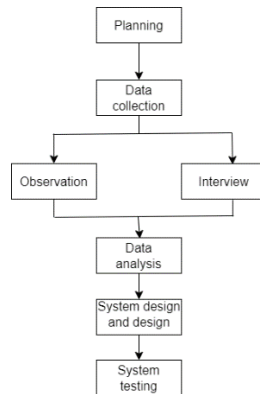


Fig. 1 Diagram of Research Stages

### A. Data Collection

Information collection in this study was obtained using interview and observation techniques. The researcher directly met with the resource person with the aim of digging up information through several questions asked. The following is a list of the researcher's interviews with the interviewees.

### B. Architecture

The development of the Javanese Script Learning Media Introduction Application with Augmented Reality technology that has been designed by android-based researchers is equipped with Markerbased tracking method, using Unity 3D tools, and Vuforia SDK as a marker storage database. The following below is a picture of the architecture model in the development of the Augmented Reality Javanese script recognition application.

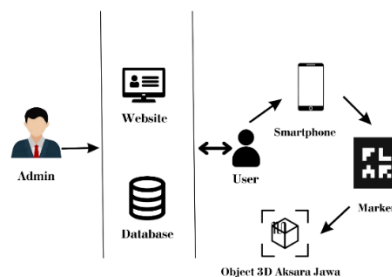


Fig. 2 Architecture

Based on the picture above, it can be explained that the architecture carried out by researchers in the development of Learning Media Applications Introduction to Javanese Script with Augmented Reality technology based on android, namely the admin manages the database and website to process information data contained in the application. Users use the Android operating system to run the application and a smartphone that has several sensor specifications including Accelerometer, Gyroscope, GPS, and the smartphone supports Arcore services to display 3D objects on markers.

### C. System Flowchart

Flowcharts naturally incorporate sequences that represent the structure and reversible flow of control that programming languages contain in simple computational models in the same way as classical flowcharts for conventional languages[10]. In this study there are two flowcharts, namely user flowchart and admin flowchart. Flowchart user explains the use of flow in the form of applications while the admin flowchart explains the use of the flow on the website system used to manage the application system.

a) User Flowcharts

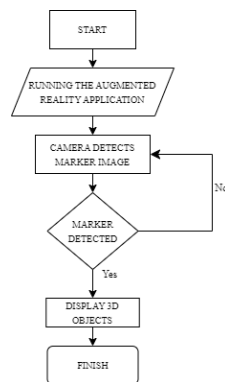


Fig. 3 System User Flowcharts

Based on the picture above, it can be explained, the user can run the application, the user can select the material menu in the application, The camera can detect the image and if the marker is detected then a 3D object will appear, if not detected the 3D object does not appear or remains on the display detecting the marker..

b) Admin Flowcharts

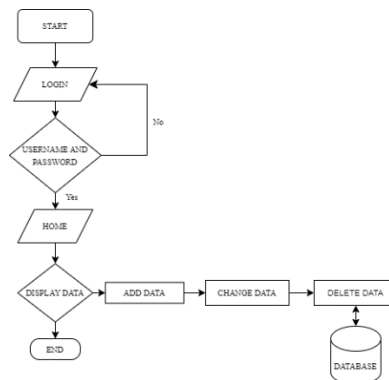


Fig. 4 System Admin Flowcharts

Based on the picture above, it can be explained that what the admin does is login using a username and password. If the admin enters the username and password incorrectly, an incorrect username or password warning will appear, and remains on the login display. Admin on the home view there is a data display menu. On the data display page the admin can add data, change data, and delete data. In these activities the processed data is connected to the MySQL database, so that the admin can display information data into the Javanese script application

D. Interface Design

The interface design on the website was created and developed using figma tools, which will be used by the admin to manage data. The website has several views, namely display data, add data, change data, and delete data.

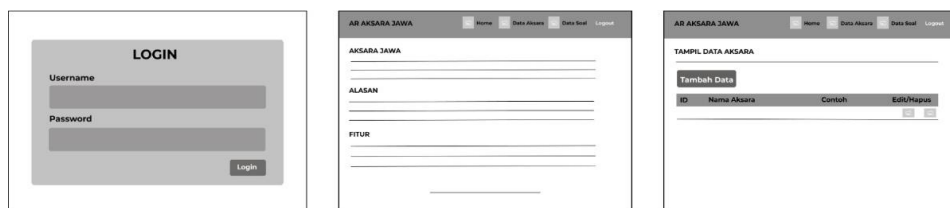


Fig. 5 Website Interface Design

Interface design on android aimed at users where there are material displays, about, quizzes, and 3D object displays



Fig. 6 Application Interface design

#### IV. RESULTS AND DISCUSSION

##### A. Website Display

Website is a platform that has an important role in application development and as a form of managing information data in the application. Websites vary in terms of page design content quality and information updating. An attractive and efficient website should contain several elements: service description, information, and ease of navigation[11]. The following below is a website display of the Augmented Reality-based Javanese Script Letter Recognition Application.

##### a) Login Page

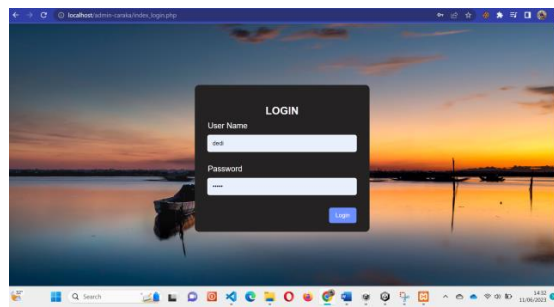


Fig. 7 Login Page Website View

The Login page is the initial display used as access to the next page, namely the admin page. This page contains several information displays that must be filled in as a condition for entering the next page, namely filling in a valid Username and Password.

##### b) Home Page

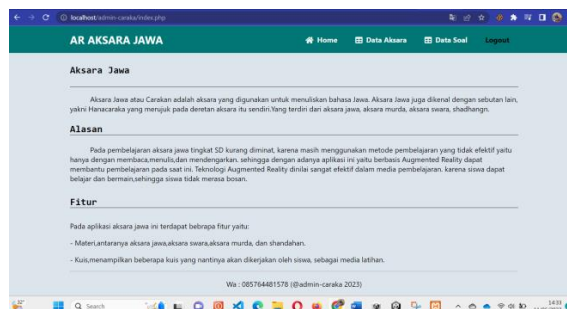


Fig. 8 Home Page Website View

The Home page is the next page that will be displayed if you successfully log in. This page contains information related to the Introduction of Javanese Script Learning Media Application with Augmented Reality technology, namely the definition of Javanese script, the reason the application was created, the features available, and admin information that can be contacted.

c) Data Display Page

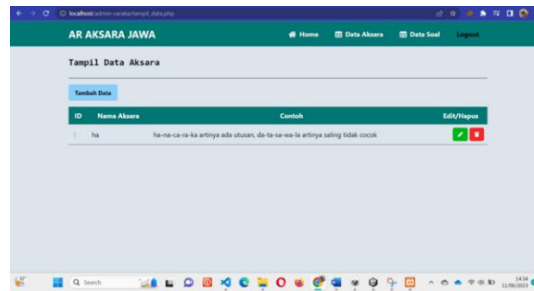


Fig. 9 Website View Data Display Page

Based on the picture above, the data display page has features including add data used to add script data, change data used to change the inputted data, and delete data used to delete script data.

d) Data Add View



Fig. 10 Website View of the Add Data Page

Based on the picture above, it explains about the data page that contains ID (automatic), script name, and example. Which will later be displayed on the application system. In adding data, the data is automatically stored in the database.

e) Data Change Page

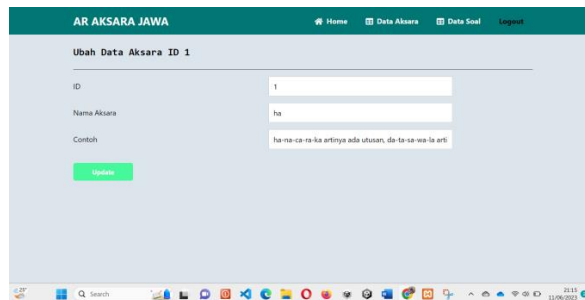


Fig. 11 Website View of Data Change Page

Based on the picture above, the data change page displays ID, Javanese characters, and examples. In the data change display, the admin is free to change the data as desired. After the admin changes the data, the data will automatically change.

f) Delete Data Page











Fig. 12 Website View of the Delete Data Page

Based on the picture above, the admin can delete the desired data. On the delete data page there will be yes and no options, if the admin chooses yes then the data will be deleted while if you choose no the data is not deleted and returns to the previous page.

**B. Marker Display**

Markers are markers used to display 3D objects. Markers can be QR codes, logos, or other markers. The following below is a table of markers used as markers in the Javanese Letter Recognition Application with Augmented Reality technology.



TABLE 2 Marker Display

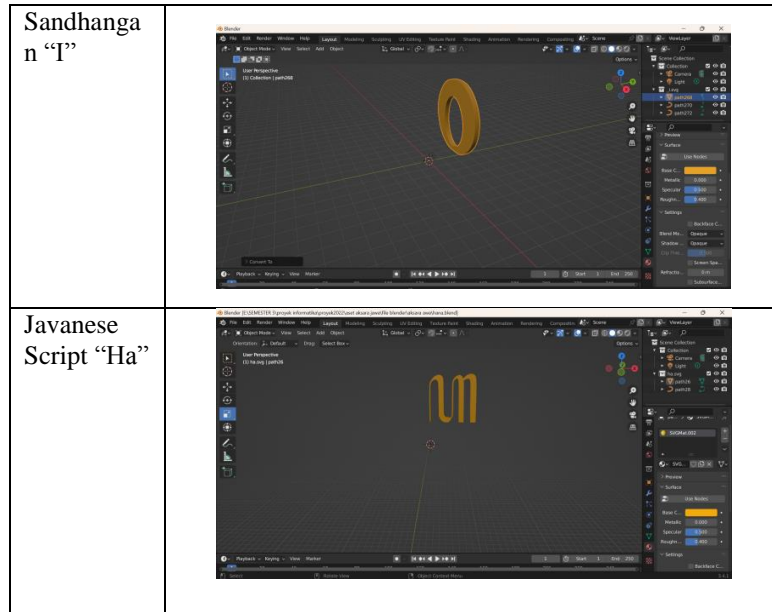
Javanese Script	Swara Script	Murda Script	Shandangan
			
			

**C. 3D Object Display**

3D object is an object that has space, volume, and coordinates (x,y,z). In the Application of Javanese Literacy Learning Media Introduction with Augmented Reality technology, making 3D Javanese letters using Blender tools. Here below are some views of 3D objects in Blender.


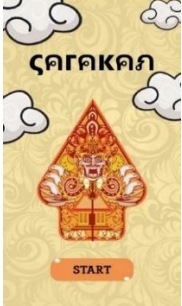

TABLE 3 3D Object Display

Huruf Jawa	BentukObjek 3D
Swara Script "Na"	
Murda Script "A"	

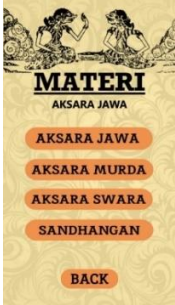





**D. Display of Augmented Reality Javanese Alphabet Letter Recognition Application**

**TABLE 4** Display of Augmented Reality Javanese Alphabet Leater Recognition Application

View	Results	Description
app logo		Display of the application logo with the application name "CARAKA".
Start		Initial view after opening the app
Main Menu		The main menu display has several menus, namely the material menu, about menu, and back.



Material Menu		This material menu has several menus including the Javanese script menu, murda script, swara script, sandhangan.
About		Display information related to application developer data.
Quiz		Displays information on practice questions about Javanese characters.
3D Objects		Display the 3D object after scanning the marker.

**E. Test Results**

In testing this system using a black box which means that its modes and operations can be very complex, invisible, and cannot be interpreted directly by humans [12]. Using the black box model, the analysis can obtain an explanation of the pass or fail status of a test, as well as identify the performance of the data against the system model. The results show that the proposed approach significantly improves the confidence of the system model with the black box[13].

**TABLE 5** Application Black Box

Menu Data	Expected Testing	Testing Results	Conclusion
Start	Successfully display the Main menu	As Expected	Valid
Material	Successfully display the material menu	As Expected	Valid
About	Successfully display the about page	As Expected	Valid
Javanese script	Successfully display the Camera to detect 3D objects	As Expected	Valid

Swara script	Successfully display the Camera to detect 3D objects	As Expected	Valid
Murda script	Successfully display the Camera to detect 3D objects	As Expected	Valid
Sandhangn	Successfully display the Camera to detect 3D objects	As Expected	Valid
Back	Successfully exit/return to the previous page	As Expected	Valid
Camera	Camera works well	As Expected	Valid
Objek 3D	Successfully display the 3D object	As Expected	Valid
Quiz	Successfully display the question	As Expected	Valid
Database	Successfully manage data	As Expected	Valid
Website	Successfully add data, change data, delete data, and display data	As Expected	Valid

TABLE 6 Website Black Box

Menu Data	Expected Testing	Testing Results	Conclusion
Login	Successfully entered username and password	As Expected	Valid
Website Display	Successfully display website information without errors	As Expected	Valid
Adding Data	Successfully display website information without errors	As Expected	Valid
Delete Data	Successfully delete data properly and in accordance with the ID that has been determined	As Expected	Valid
Change Data	Successfully change the data with the data to be changed and in accordance with the data criteria	As Expected	Valid
Database	Successfully save data such as username, password, and script data	As Expected	Valid
Logout	Admins can log out easily and securely	As Expected	Valid

## V. CONCLUSIONS

The importance of recognizing, learning, and promoting the culture that has been passed down since ancient times, especially in Javanese cultural arts which are currently less attractive to be learned by elementary school students. Introduction of Javanese Script Learning Media Application using Android-based Augmented Reality technology as a media that presents various features in it to encourage student interest in learning cultural heritage. *Augmented Reality in making applications is one aspect to increase user interaction with works virtually and in real time.* Based on the results of research and discussion conducted in the Application of the Introduction of Javanese Literacy Learning Media, namely designing a Javanese Literacy learning system using Augmented Reality technology and Marker based tracking methods can help elementary school students carry out learning activities wherever and whenever they are. There are features in the Introduction of Javanese Script Learning Media Application using Augmented Reality technology, namely, Javanese Script material, Swara Script material, Murda Script material, and Sandhangan material. The use of the Javanese Script Recognition Learning Media Application using Augmented Reality technology can be through an android-based smartphone with several sensor specifications in it.

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