



Introduction to Characteristics of Authenticity in Rupiah Based on Augmented Reality

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ABSTRACT

This research is developing an application introduction to the characteristics of the authenticity of the rupiah by applying a system of Augmented Reality (AR) on android mobile devices. The Act of forgery of currency has a broad impact and is very detrimental to society. Congressional education applications introduction to the characteristics of the authenticity of the rupiah using augmented reality technology by applying techniques of marker-based tracking. This research made RUPIAR with the Multimedia Development Life Cycle (MDLC) method. Based on the testing that has been done, the results of the alpha testing are already functionally fit. From beta testing, test results from User Acceptance of functionality Test (UAT) obtained the value of 89.68%, declared eligible for use with the interpretation "Good", which means the application is worthy of being used and can be developed.

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1. Introduction

Rupiah banknotes are money from sheets made of paper or other materials issued by the Indonesian government. In this case, Bank Indonesia and its use is protected by Law No. 23 of 1999 and is legally used as a medium of exchange of payment in the territory of the Unitary Republic of Indonesia.

Money functions as a medium of exchange in the form of any object that everyone in society can generally accept and as a standard unit of value. Money will impact human culture if applied as property, which determines a person's dignity in society. Everyone is trying to get money, so besides getting the cash by lawful or not breaking the law, there will always be someone looking for a shortcut and trying to get it by way of deviating. Such deviations in legal language are identified as criminal acts, one of which is currency fraud.

The act of counterfeiting money has an extensive impact and is indeed very detrimental to the community. The prevailing currency in Indonesia circulated by Bank Indonesia is regulated in Act Number 7 of 2011 concerning currency (the Currency Act). Article 2, paragraph (1) of the Currency Law states that the money of the Unitary State of the Republic of Indonesia is Rupiah. Rupiah has a characteristic on each nominal that is determined to show identity, differentiate price or nominal value, and secure the rupiah from counterfeiting efforts. Special features contained in the rupiah are regulated in Article 5, paragraphs (3) and (4) of the Currency Law. This particular feature is intended as a security and is contained in the rupiah's design, materials, and printing techniques. Currency has unique properties that are open, semi-closed, and closed. This particular feature is used to recognize the rupiah from counterfeiting in the form of currency imitation. Counterfeiting of currencies is classified as a crime [1].

The research solution to be taken is to design and build information applications using Augmented Reality technology that can determine the characteristics of the authenticity of rupiah money and produce information on banknotes in 3D and audio format. The development of this application uses Unity 3D with the addition of the Vuforia Library [2]. The Vuforia Library is used to convert banknote images into markers. The markers are uploaded and stored in the Vuforia SDK database. Markers stored in the database will be configured to be detected by the camera before the settings are made to produce 3D objects and audio.

2. Materials and Method

2.1. Research Method

The flow method in this research uses descriptive research methodology [3] with the following framework, as shown in Figure 1.

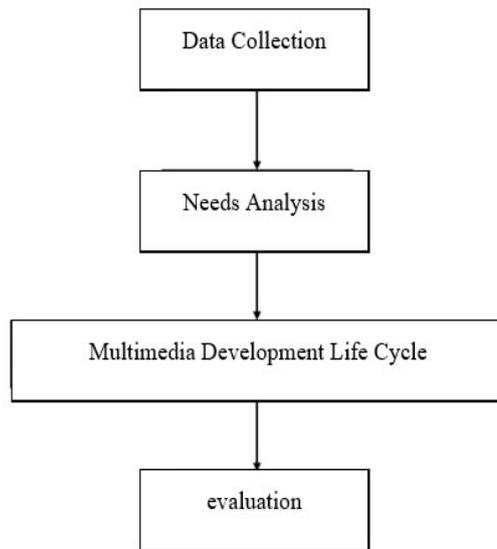


Figure 1 Research Framework [3]

2.2. Material Collecting

This stage includes the collection of assets and materials according to the needs of multimedia products to be built.

2.2.1. Rupiah Marker

A marker is used as a marker object or target that serves to identify the 3D object that will be displayed [4-7]. Markers are generated in the form of *.JPG files. Markers will be uploaded to the Vuforia website and converted to *.unitypackage containing dataset, used as a basis for determining orientation and location in the tracking process by the camera. These markers can be seen in Table 1.

Table 1 Rupiah Marker [8]

No	Marker's Name	Picture
1.	Marker 100k.jpg	
2.	Marker 50k.jpg	

No	Marker's Name	Picture
3.	Marker 20k.jpg	
4.	Marker 10k.jpg	
5.	Marker 5k.jpg	
6.	Marker 2k.jpg	
7.	Marker 1k.jpg	

1. Upload image to Vuforia site Markers to start the proses. The steps before uploading the Marker to the vuforia site must first create a vuforia account. After the account is created, the next step must be to create a database by

visiting the target manager and then adding the database. Click the add target to upload the Marker in the database. Then, upload the results of the Marker that has been made according to the directions of vuforia. The following process displays the results of the Markers that have been uploaded into the vuforia database. A 1-5 star rating description indicates that the higher the star rating, the easier the system will scan and detect the Marker object and download the Marker database by clicking download database, the database format *.unitypackage, if the stage is successful, it will look like in Figure 2.

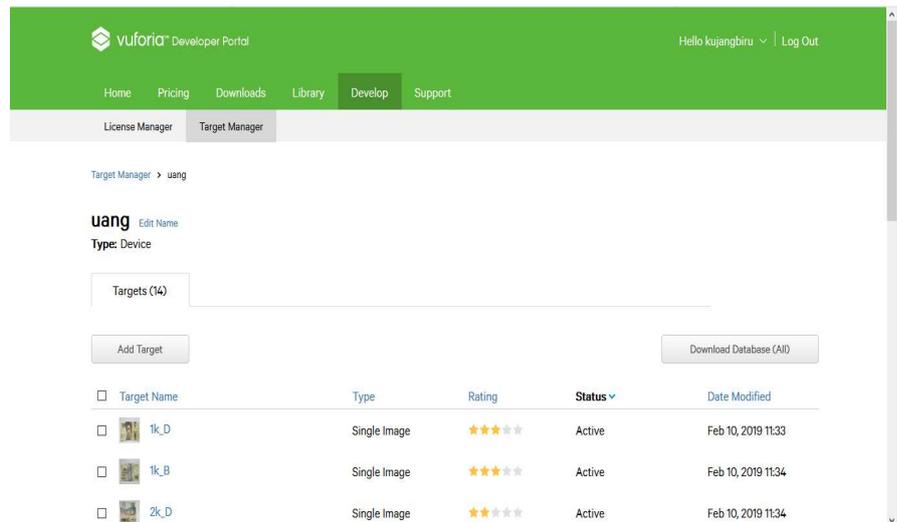


Figure 2 Successfully Uploaded Marker

2. Detection marker process. Marker detection results are the introduction of the pattern by detecting or tracking the points (interest points) and corners (corners) in an image [9-13], the results of the marker detection look like in Figure 3.

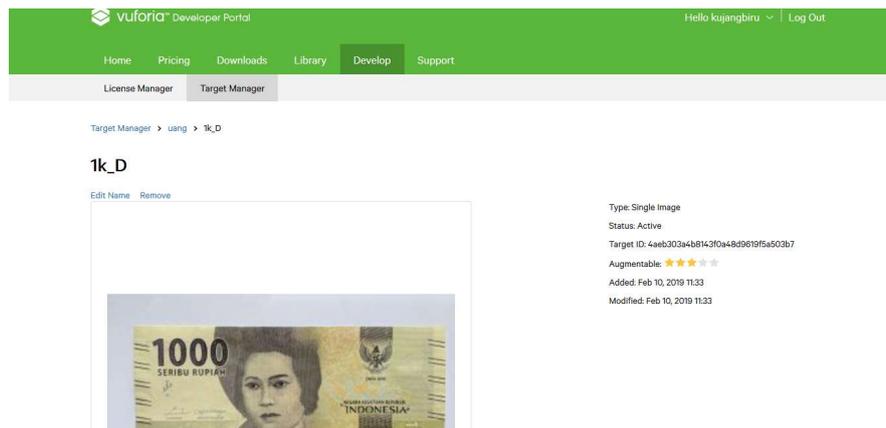


Figure 3 Marker Detection Results

Detection is carried out on the outside pattern of the image then an edge analysis is performed to get the suitable corner detection.

1. 3D object creation and animation; making 3D objects and animations using unity. The object created is a button.

2. Making User Interface; this stage is shown to implement the interface design that will be applied to the application to be created, the user interface design using the Adobe Illustration application. The user interface can be seen in Figure 4.



Figure 4 User Interface Creation Process

The Start Menu displays 3D objects when the user points the camera at the Marker, as shown in Figure 5.



Figure 5 Detection Marker

Details:

- Number 1: Security Thread
- Number 2: Money Nominal
- Number 3: Bank Indonesia Logo
- Number 4: Caption
- Number 5: BI Element
- Number 6: Watermark
- Number 7: Money Serial Number
- Number 8: Security Thread
- Number 9: Latent Image

2.3. Testing

This stage includes testing products that have gone through the assembly stages to see the possibility of an error. This stage can be done by the alpha and beta test methods [14].

2.3.1. Alpha Testing

Alpha test stages using the black box testing method. The alpha testing is as follows. The alpha testing stage uses the black box testing method. The alpha test can be seen in Table 2, Table 3, and Table 4.

Table 2 Blackbox Testing of Each Menu

No	Input Data	Expected results	App Response	Result
1.	Start Button	Enter the scan scene	Enter the scan scene	Accepted
2	Gallery Button	Show information video	Showing video panel	Accepted
3	About Button	Displaying information about the application	Pictures and information	Accepted
4	Exit Button	Stop accessing the app	App stopped	Accepted
5	Sound Button	Turn the sound on and off	Sound on and off	Accepted

Table 3 Gallery Testing

No	Input Data	Expected results	App Response	Result
1.	Push Gallery Button	Show information video	Showing information video	Accepted
2	Push Exit Button	Exit gallery view	Closing information	Accepted

Table 4 About Testing

No	Input Data	Expected results	App Response	Result
1.	Push About Button	Displaying information about the application	Showing Image	Accepted
2	Push Exit Button	Exit Testing view	Closing information	Accepted

2.3.2. Beta Testing

This beta testing phase will take data using a survey method by filling out questionnaires to end users. The purpose of distributing this questionnaire is to get feedback or feedback from users who will use the application created. Beta testing is done to get the function of information with the VISUALS approach as an aspect to be obtained. VISUALS means appropriate material from sources that have been collected and present the contents of each topic in a concise, simple, and communicative language, supplemented by illustrations or visualizations in the form of images, graphics, diagrams, photographs, animations, or audio and video. The stages of beta testing are shown in Table 5.

Table 5 Likert Scale

Score	Variable	Information
3	B	Good
2	C	Enough
1	K	Not enough

The results of the beta test are carried out by distributing questionnaires around the house and campus given to people who understand the application and to determine the number of respondents only the sample is taken, using the Likert scale method because the large population uses the formula.

Interval Formula

$$I = 100 / \text{Total score (Likert)}$$

I = 100 / 3
 I = 33,33%

The results of the lowest interval of 0% to the highest 100% can be seen in the Table 6.

Table 6 Likert Scale Percentage Interval Value

Percentage	Criteria
0% - 33.32%	Not enough
33.33% - 66.65%	Enough
66.66% - 100%	Good

The total number of respondents who filled out the questionnaire was 30 people. The following is the percentage of results from processing the questionnaire The total number of respondents who filled out the questionnaire was 30 people. The following is the percentage of results from processing the questionnaire, shown in Table 7.

Table 7 Questionnaire Results

No	Aspect	Question	B	C	K	Score	Percentage	Information
1.	Visible	1	78	8	0	86	95.56%	Good
		2	78	8	0	86	95.56%	Good
		3	84	4	0	88	97.78%	Good
2.	Interesting	4	39	34	0	73	81.11%	Good
		5	57	22	0	79	97.78%	Good
		6	27	42	0	69	76.67%	Good
3.	Simpel	7	72	12	0	84	93.33%	Good
		8	72	12	0	84	93.33%	Good
		9	63	27	0	90	100%	Good
4.	Useful	10	75	15	0	90	100%	Good
		11	54	24	0	78	86.67%	Good
5.	Accurate	12	48	28	0	76	84.44%	Good
		13	57	22	0	79	97.78%	Good
		14	33	38	0	71	78.89%	Good
		15	30	34	3	67	74.44%	Good
6.	Legitimate	16	48	26	1	75	83.33%	Good
		17	60	20	0	80	88.89%	Good
		18	39	32	1	72	80.00%	Good
7.	Structure	19	72	12	0	84	93.33%	Good
		20	66	16	0	82	91.11%	Good
		21	72	12	0	84	93.33%	Good
Total						1677/21 = 79.86	1883.33%/21 = 89.68%	Good

Tests were carried out using a Likert scale with the results in the table. The results of the average percentage produced are 89.68% showing that rupiAR is in the excellent category.

2.4. Distribution

This stage is the last in the manufacture of multimedia products. The results of this study produce a multimedia product. The product produced is the application itself which is equipped with 14 Markers [15][16].

The advantages of RupiAR application are as follows.

1. A 3D point object is displayed according to its placement in each of its Markers.
2. In the pop-up there is information dubbing.
3. Camera mode uses the autofocus mode when scanning markers.

3. Conclusions

Based on the results of the research conducted, the following conclusions were obtained.

1. The rupiAR application facilitates the public to recognize the authenticity of rupiah currency using concrete and interactive Augmented Reality technology.
2. Application of marker detection in rupiAR applications using marker-based tracking techniques with emission banknote 2016 markers defined in vuforia so that it becomes a database that will be used at Unity as a function for calling 3D objects.

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