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BandoAR: Real-Time Text Based Detection System Using Augmented Reality for Media Translator Banjar Language to Indonesian with Smartphone

Aulia Akhrian Syahidi
Media, Game, and Mobile Technologies Research Group,
Master of Computer Science
Brawijaya University
Malang, Indonesia
aakhriansyahidi@student.ub.ac.id

Herman Tolle
Media, Game, and Mobile Technologies Research Group,
Master of Computer Science
Brawijaya University
Malang, Indonesia
emang@ub.ac.id

Ahmad Afif Supianto
Media, Game, and Mobile Technologies Research Group,
Master of Computer Science
Brawijaya University
Malang, Indonesia
afif.supianto@ub.ac.id

Kohei Arai
Graduate School of Science and Engineering, Department of Information Science
Saga University
Saga, Japan
arai@is.saga-u.ac.jp

***Abstract*—Language is one of the fundamental factors that distinguish humans from animals. Language allows individuals to live together, help solve problems and position themselves as cultured beings. Language is a communication medium that aims to understand each particular ethnicity and nation. Language comprehension allows increased awareness and value of closeness between individuals in an area. However, a large number of languages seem to be the cause of difficulties and misunderstandings about the meaning of certain words. This research provides alternative solutions for solving these problems. This solution can provide convenience in the process of understanding the meaning of language words, especially Banjar Language, by recommending an application called "BandoAR". BandoAR is a translator application from Banjar Language to Indonesian. This application can work as a real-time application without requiring input media such as text that must be typed using a good camera quality and has autofocus characteristics on the camera. This study emphasizes the process of detecting and tracer texts that exist in the Banjar community. This research is intended to see how Augmented Reality technology can be applied in the text without markers and has different font sizes, backgrounds, and distances. The results show that software for Android smartphones, as a media translator in real time, can be used in almost every type of smartphone. Based on internal trials and the results of 160 respondents, this application can attract users' interest, can be applied in real life, and as an effort to preserve Banjar Language culture.**

Keywords—real-time, augmented reality, media translator, smartphone, Banjar language, Indonesian cultures

I. INTRODUCTION

Language as a function of communication allows two individuals or more express ideas, meanings, feelings, and experiences. That is why language is one of the important factors in the lives of people in the world. Language is a means of communication or communication between members of the community consisting of individuals who express their thoughts, feelings, and desires. The community uses language as an arbitrary symbolic system of sound (at will) to work together, interact, and identify themselves. Speaking means using language based on individual knowledge about customs and manners.

The Indonesian nation consists of various ethnic groups. Every ethnic group has its language. The language used by each ethnic group is known as the name of the local language. Regional languages scattered throughout the country are one of the nation's wealth assets. Therefore, to maintain the regional languages, we need to develop, preserve, and develop them. Indonesia has a population of hundreds of people, has recorded more than 750 regional languages, making Indonesia the country with the largest regional language in the world. However, there are around 160 languages that are threatened because of the lack of depth of regional languages.

Banjar language is one of the regional languages in the province of South Kalimantan. The local language is used as a communication tool by the Banjar community. In addition to being a communication tool, the Banjar language functions as an identity or identity for the speakers. Banjar language also has a very important function, namely as a reflection of the social condition of the community. Banjar language as an identity or identity and mirrors the social condition of the community has a unique and unique [1].

The uniqueness and distinctiveness must be maintained and preserved today so that Banjar Language is not extinct and can be enjoyed by every future generation. Based on instructions from the Regional Leaders of the Province of South Kalimantan and the City of Banjarmasin through the Office of Culture and Tourism, striving to keep preserving Banjar Language, continue to strive to socialize Banjar Language usage in daily activities in the community.

Language as a regular symbol system to transfer various ideas and information consisting of visual and verbal symbols. These visual symbols can be seen, written and read, while verbal symbols can be spoken and heard. Children can manipulate these symbols in various ways according to their thinking abilities [2].

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There are two definitions of language. The first definition states that language is a means of communication between people in the form of sound symbols produced by human vocal organs. Second, language is a communication system that uses arbitrary vocal symbols (speech sounds) [3]. Another definition, language is a form and not a state or arbitrary sound-symbol system, or also a system of many systems, sequence systems or system sequences [4]. Written text is one of the most common methods for conveying information in our daily lives. However, when the text is found in a foreign language for several individuals, the information cannot be delivered [5].

The foreign language here can be interpreted as a language that is not understood by many people such as regional languages, so that information cannot be conveyed properly. Only certain communities can understand their respective regional languages. Especially if some foreigners or tourists do not understand regional languages, it is also very difficult to communicate.

So, to overcome the problem based on the previous statement, a tool is needed that acts as a translator, ranging from simple dictionaries to electronic devices that simplify the translation process. One recommended solution is the use and application of AR technology in the text of Augmented Reality (AR) technology applications that are rarely used in text-based writing. The application named "BandoAR." BandoAR is a translation application from Banjar Language to Indonesian based on AR. This application can work as a real-time application without requiring input media such as text that must be typed using a good camera quality and has autofocus characteristics on the camera. AR research mostly focuses on the use of markers, to display objects, and interactions using additional markers. There is still little use of AR with the Markerless method, especially the use of AR-based text, which means that the detected image is converted to text form. Also, the use of AR using smartphones will add value to higher mobility. However, this research emphasizes the process of detecting and tracer texts in the Banjar community. This research is intended to see how AR technology can be applied in the text without markers and has different font variations. This application is expected to be able to attract user interest, can be applied in real life, as well as an effort to preserve the culture of the archipelago, especially the Banjar Language culture.

This paper is compiled from section I of the introduction. Related work is presented in section II. Section III describes the framework for the proposed method and system. The result and discussion are presented in section IV. Last is the conclusion and future work in section V.

II. RELATED WORK

The system for semi-automatic and automatic vision-based translation (computer vision-based translation) has previously been proposed to initiate, for example from 2001-2005 research by [6][7][8][9]. However, everything is based on a client-server architecture to offload expensive operations (detection, extraction, and translation) and therefore cannot operate without a network connection or provide immediate feedback.

Research in the new era in 2010 proposed by [5] has presented a mobile-based Augmented Reality translation system, but in this study the user must first touch the screen to choose the words to be translated, this technology is a solution to the system does not just use a client-server architecture but can be offline.

Subsequent research in 2015 [10] proposed is to present applications on mobile phones that translate Chinese menus into 3D menu models and menu names in English. This system runs on Android platform phones. It uses image recognition to track and register image markers (in this paper the Chinese word). The research proposed by [11] paper is presenting an AR text-based framework that performs OCR on natural images and replaces recognized text with other informative content. Specialized in the application of text detection and recognition functions, and developing an image augmentation algorithm for realistic content replacement.

The proposal from [12] is to present a speech that allows the AR smartphone application for Hindi translation to English and vice versa. The application will be very useful for tourists who want information in their native language. Text to Speech output will be an added advantage for different people. Students can use this application to learn languages and word pronunciation. We hope to integrate the multilingual interface along with voice recognition so that it makes it more comprehensive and accessible.

Research by [13] is to make Balinese Scriptwriting learning media packaged in the form of AR applications in gadgets by implementing the Android operating system, which is expected to be a solution to increase user interest in learning Balinese script. The Balinese Script learning media application based on AR focuses on learning how to write Balinese Manuscripts, here they use multi-target markers to detect images. This research raises the Balinese manuscript which is one of the riches of Balinese culture that must be preserved.

Research with the same topic, which is about preservation of Banjar Culture, was conducted by [17] who proposed the design and implementation of an educational game called Bekantan Educational Game (BEG) which contained material games and quizzes, but he only focused on educational games as Banjar Language learning media, has not applied AR in his research.

The research proposed now is a combination of an unmarked and working method in real time. See how Augmented Reality technology can be applied in the text without labels. See the performance in three different conditions, namely variations in font size, different backgrounds, and distances. This is expected to be tested and implemented internally. The results of the questionnaire that will be distributed to many respondents are expected to attract users to try and apply. This research is an effort to preserve Indonesian culture, especially Banjar Culture with certain topics in Banjar Language.

III. PROPOSED METHOD AND SYSTEM

Augmented Reality (AR) is the integration of digital information with the user's environment in real-time, where this AR technology uses the environment in the real world then adds new information on it with the help of computers, webcams, Android smartphones, and special glasses like Google Glass.

AR is the combination of digital objects in the form of two dimensions and three dimensions with the real world. Augmented reality, which is a system that has the character of (a) combining real and virtual environments; (b). Run interactively in real time, and c. Integration in three dimensions (3D). The purpose of the AR system is to increase user perceptions and interactions with the real world through complementing the real world with 3D virtual objects that appear to coexist in the same place with the real world [14]. Virtual Reality (VR) and Augmented Reality (AR) are technologies that are both used in real-world modeling into computer systems to help and support human activities. In the use of AR technology, users are in a virtual space while still having nuances in real life. VR and AR technology can be combined with 3D display [15].

There are two marker recognition algorithms in AR, namely markers and markerless. Markers are special markers that are made like a barcode or a black frame, while markerless is a marker that deals directly with objects. Marker evolution is indicated by changes in markers starting from barcode form to real form in life. Markers are classified into two, namely markers and markerless. Marker evolution included in the marker classification or known as technical markers, namely barcodes, QR codes, and printed AR markers. While those included in markerless (natural markers), namely natural printed AR markers and real-life markers [16], and in this study using a markerless marker recognition algorithm that can read objects in the real world.

Vuforia uses Computer Vision technology to identify and track planar images (Target Images) and simple 3D objects such as boxes, in real-time. Image registration capabilities allow developers to adjust the position and orientation of virtual objects, such as 3D models and other media, in connection with real-world images when viewed through a mobile device's camera. The virtual object then tracks the position and orientation of the image in real-time so that the user's perspective on the object matches the perspective of the target image, so that virtual objects can be displayed in the real world. Vuforia SDK supports various types of targets including Markerless 2D and 3D images, multiple 3D targets, and forms a frame marker. Additional SDK features include local collision detection using virtual keys, you can choose target images in real time, and the ability to calculate at runtime. Vuforia provides Application Programming Interfaces (APIs) in C ++, Java, and Objective-C.

There are many mobile applications for translators available, but most of them still use text input methods regarding their use. AR technology offers something new, how objects are detected in real time, this is what is behind if as objects are text, do real-time detection and produce translations that have been generated by media-based AR. Vuforia can detect words included in the list of predefined words. The SDK provides a list of 100,000 commonly used English words that you can enter into your Text Recognition application. You can also specify a list of special words and filters that block words from being recognized.

Text recognition is useful for applications that need to recognize individual words and series of words. You can use Text Recognition as a stand-alone feature or in combination with a target. Text recognition is used for children's educational games, and as a visual input mechanism (for use in dictionaries). The Vuforia, text recognition engine, relies on UTF-8 character encoding standards and can recognize any character listed in it. Figure 1 shows the method in the process of detecting and translating text in the BandoAR system.

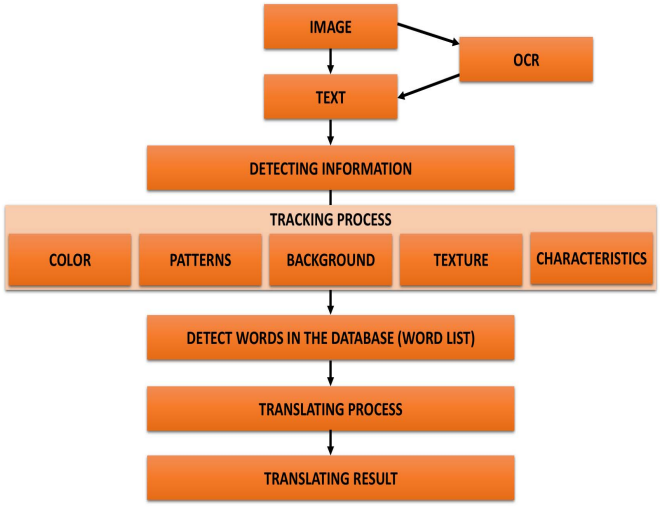

Fig. 1. Detection process method

Vuforia makes the detection and tracking of text elements by performing a camera display scan called the Region of Interest (ROI). This technology uses two different ROI, one for detection and one for tracking. Regarding performance, detection of too many words in one track will cause longer detection times and slow system response. When text detection is activated, Vuforia tries to match the words found in ROI with words in a set of reference databases called word lists. A word database containing words used to process the translator. Word lists can be loaded from files and can be expanded with additional words specifically for application use cases. Word lists can also be filtered using a filter list to exclude certain words from being detected (using a black-list filter), or only allowing certain words to be detected (using a white-list filter).

Word lists represent a collection of basic words that Vuforia can use as references to suitable text elements that appear in the camera-view field. Word lists are taken from binary files encoded in the Vuforia Word List (VWL) format. The default VWL file contains more than 100,000 high-frequency English words and is distributed in bundles with the Vuforia SDK. The default word list can be extended with additional word lists and word lists can be filtered. The combined use of these two mechanisms (additional words and filters) offers developers the flexibility to adjust the text recognition behavior to cover a variety of use cases, which

currently contain a database of a collection of words in Banjar Language.

Next test, this test aims to determine the minimum requirements in recognizing the text as the target image. This test will use two types of smartphones with different capabilities and specifications. The test is carried out by determining the distance of 15 cm as shown in Figure 2.

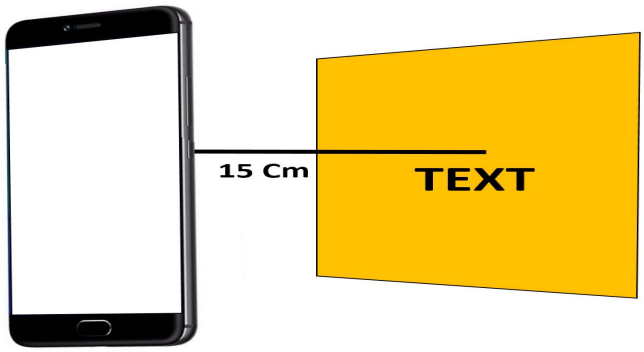

Fig. 2. Distance for detection

IV. RESULT AND DISCUSSION

Tests were carried out to see the system's ability to detect text, but this has not been translated at the beginning of internal testing, this test is to see the system's success rate when it detects text, the testing process as shown in Figure 3.

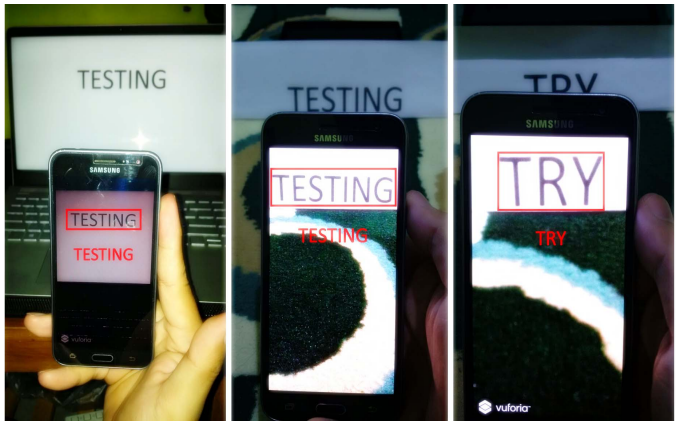

Fig. 3. Test of text detection

Based on the tests that have been carried out, it can be concluded that the system difficulty level if it detects text with three different conditions as described above, the results are presented in Table 1.

TABLE I. TEXT DETECTING TEST RESULTS

Tested Conditions	Test Result			
	Figure 1	*Figure 2*	*Figure 3*	*Figure 4*
(TP-1) Test with different font sizes	5/5 (100%)	5/5 (100%)	5/5 (100%)	5/5 (100%)
(TP-2) Tests with different background colors	(80%)	(100%)	(80%)	(100%)
(TP-3) Tests with different distances	5/5 (100%)	4/5 (80%)	5/5 (100%)	4/5 (80%)

Markerless Banjar Language collection is available as a means to try BandoAR, shown in Figure 4.

Fig. 4. Markerless Banjar Language

Based on the analysis carried out on the test, the results can be concluded that the BandoAR application has no text problems, as long as the text still has a standard pattern on paper, this application also has no color problems in conditions where the text color is too contrasted with the background, so the system does not too difficult in terms of text detection. Test results are presented in Table 2.

TABLE II. TEST RESULTS WITH DIFFERENT SMARTPHONE DEVICES

Tested Conditions	Detection Results	
	Samsung Galaxy J3-6	*Samsung Galaxy J7*
TP-1	Succeed	Succeed
TP-2	Succeed	Succeed
TP-3	Succeed	Succeed
TP-1 + TP-2	Succeed	Succeed
TP-1 + TP-3	Succeed	Succeed
TP-2 + TP-3	Succeed	Succeed
TP-1 + TP-2 + TP-3	Succeed	Succeed

Tests with different font sizes have been detected, tests with different background colors have also been detected, tests with different distances have also been detected, and combinations of conditions have also been detected with a

successful status. But here it has a less good detection when the background is dark and the font size is small. The test results are shown in Figure 5.

Fig. 5. BandoAR internal implementation and test

Assets can be said to be the main component to be used in displaying AR. In making BandoAR, this consists of several parts, they are VWL assets that function as text databases, and text as image target assets. VWL is a vuforia package database that contains texts that will be detected by the system. In this application, use the file named "banjar_language_utf8" which contains 100 words in the Banjar language in this study, which is a word that will later appear to detect the text to be translated. As an additional note, if the detected word is not found in this database, the word cannot recognize so that the detection process will fail. System applications built on Android-based smartphones consist of several main parts, such as asset imports, implementation of the splash screen function, initialization, rendering, and deinitialization. In displaying text, the text that functions as the target image to be imported first into the source code. This is because the program still captures text as an image before it is converted to text, the conversion process uses OCR (Optical Character Recognition), so the letters in the images are matched with each database which is then displayed on the screen.

If you are building a text recognition application, consider the following suggestions: (a) Provide visual feedback for the detection of ROI that visually represents the ROI area. For example, draw a rectangle around the ROI or darken the outside area to clearly show the user which part of the camera display can be used for word detection. (b) Determine ROI according to the expected text layout. For example, an area with a small height will usually function properly when only a few words in the same line are expected. However, areas with higher heights function better when the expected words are arranged on several lines. (c) Avoid unnecessary large ROI detection. The size of the detection ROI can affect performance. In particular, larger areas can result in longer detection times and less satisfying user experiences. (d) Consider using the optimal size that suits your application needs. Consider the expected orientation of the device, which is when the user tries to detect a piece of text. Determine the direction of your detection ROI after considering the expected orientation.

BandoAR takes input text data based on the words found in VWL, a database called banjar_language_utf8. After the image is detected as text, the system looks for the text in the database that will be displayed. Before displaying text, you must first initialize the camera and render settings. First choose which camera to use, because there is a smartphone having two cameras, then initialize the camera, turn on the camera and start the tracking function. After initializing the camera, initialization rendering can be done. Initialization rendering aims to produce textures using OpenGL, making settings to be displayed using OpenGL and OpenGL settings for text display. After displaying the text and the application that has been used, not to be stored in the buffer should be de-initialized the camera smartphone to triangulate. This test uses an Android-based smartphone with various specifications. This test uses four different types of smartphone specifications. The smartphone used has a significant hardware difference, regarding processor performance and RAM capability so that it can be a variation to test the BandoAR system. Thus, it can be seen the influence of the processor, RAM, Graphics Processing Unit, and the performance of the BandoAR system.

Following are the results of the questionnaire that has been distributed to 160 respondents, shown in Table 3.

TABLE III. BANDOAR QUESTIONNAIRE RESULTS

Questions	Answers			
	Yes	*No*	*Yes (%)*	*No (%)*
(1) Are you a native of Banjar?	104	56	65	35
(2) Do you understand Banjar Language well?	110	50	69	31
(3) Have you ever used technology to translate Banjar Language into Indonesian?	26	134	16	84
(4) Is it important for technology to preserve Banjar Language?	158	2	99	1
(5) Have you ever known about Augmented Reality (AR) technology?	81	79	51	49
(6) The recommended technology is to apply Augmented Reality (AR) to translate text from Banjar Language to Indonesian, the application of which is named BandoAR. Do you support this research project?	158	2	99	1
(7) When this BandoAR technology will be tested and applied, are you interested in trying it out?	155	5	97	3
(8) When this BandoAR technology will be tested and applied, are you interested in implementing it?	149	11	93	7
(9) Can BandoAR technology help someone (not a native of Banjar/Tourist) as a medium for translating Banjar Language into Indonesian?	158	2	99	1
(10) Is the collaboration between Banjar Culture and Augmented Reality technology in the form of BandoAR applications can affect the preservation of Indonesian culture, especially Banjar Culture?	154	6	96	4

Based on the results of Table 3, in the number 1 question that there were 104 respondents equivalent to 65% who participated in filling out the questionnaire was a native of Banjar, and 56 respondents were equivalent to 35% who were not indigenous Banjar. Question number 2 that 110 respondents were equivalent to 69% understood Banjar Language well, and 50 respondents were equivalent to 31% did not understand Banjar Language well, did not even know Banjar Language because of the effect of question number 1 which is not expected to be a native Banjar. Question number 3 that 26 respondents were equivalent to 16% had used technology to translate Banjar Language into Indonesian, and 134 responses equivalent to 84% said they had never used technology to translate Banjar Language into Indonesian, this was a great opportunity for this research. Question number 4 that 158 respondents are equivalent to 99% stated that the technology is important to preserve the Banjar Culture in the present and 2 respondents equivalent to 1% said it was not important. The number 5 question about 81 respondents is equivalent to 51% have known Augmented Reality technology, and 79 respondents equivalent to 49% have never known about Augmented Reality technology. The 6th question number that 158 respondents were equivalent to 99% supported this study and 2 respondents equivalent to 1% did not support this research. The 7th question number around 155 respondents equivalent to 97% stated that they were interested in trying BandoAR and 5 respondents equivalent to 3% were not interested in trying BandoAR. The 8th question number that 149 respondents equaled 93% expressed interest in applying BandoAR in the Banjar community, and 11 respondents equivalent to 7% were not interested in implementing BandoAR. The 9th question number around 158 respondents is equivalent to 99% stating that BandoAR can help someone (not a native Banjar resident/tourist) as a medium of Banjar Language translator to Indonesian and 2 respondents equivalent to 1% said they could not help. The 10th question number that 154 respondents are equivalent to 96% states that with the collaboration of Banjar Culture and AR technology in the form of BandoAR application can affect the preservation of the culture of the archipelago, especially Banjar Culture and 6 respondents equivalent to 4% said it did not affect.

V. CONCLUSION AND FUTURE WORK

From the results of design, implementation, testing and elaboration it can be concluded that: BandoAR application is a media translator from Banjar to Indonesian, designed using a Java programming language that can be operated on Android devices, to be displayed using Vuforia Augmented Reality SDK and rendering using OpenGL and technology OCR as an additional reading of images as text. By applying AR using the Markerless technique on BandoAR, it does not limit the user to detect certain text or images. So that users are free to detect any text recorded in the database. With various tests carried out on BandoAR's performance, it has been proven to work well and can know BandoAR's performance limits. AR can be innovation and alternative text solution in the Android-based translator media to improve the quality of software for education, especially to study the Banjar culture. From a survey of 160 respondents by distributing questionnaires, very good data was obtained to support the continuity and continuation of BandoAR's research. The expected future work is to do an accuracy analysis, implement the application used for the Banjar community environment in real terms, and evaluate the use of the application to generate feedback as an effort to develop applications in the future.

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