An Augmented Reality Machine Translation Agent

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Submission date: 30-Jan-2022 04:32PM (UTC+0700)
Submission ID: 1750979396
File name: P8.pdf (495.5K)
Word count: 3076
Character count: 16994

An Augmented Reality Machine Translation Agent

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Keywords: Machine Translation, Augmented Reality, Chatbot.

Abstract: English is a language used as a universal communication tool. Therefore, without English skills, a person will have a difficulty to communicate properly and correctly in the international scope. This research developed an application of augmented reality-based translating machine that provides the education to students with different media in order to increase students' interest in learning English. This application used library Vuforia sdk which is able to display 3-dimensional characters with markerless techniques in the form of augmented reality. The final result of this study was an application that can be used on smartphones with Android operating system. Based on the results of the application testing, it is concluded that this application can display 3-dimensional characters in dim light with light intensity of 28 lux at a distance of 10cm-60cm and viewing angle of 10°-90°. After reviewing the application, 95% of the correspondents stated that this application is good so it can help students to relearn English outside the school.

1 INTRODUCTION

According to Yamin (2017), the current development of information technology makes all developing countries improve the quality of their human resources as an effort to face global competition. English is one language that is used as a universal communication tool in the international scope.

Moreover, Galih et al. (2017) states that English iscurrently a foreign language introduced in elementary schools because children aged 6-12 years have a brilliant learning period called the golden age (Saputra and Indonesia, 2014; Pangestika et al., 2017; Mariani and Ananta, 2017).

The learning facilities at school are still conventional in which teachers deliver the lessons assisted by textbooks as teaching guides in front of the class. As a result, this makes students less interested in the learning process.

This research generates a system in the form of an attractive English learning tool to increase children's learning interest at the school age. This system translates a text into sound in Indonesian to English and vice versa. A smartphone is needed as a medium to run the application. Characters in 3-dimensional form will translate questions from users, either words or sentences that have been previously inputted (Dikdok, 2017; Efendi, 2014).

2 LITERATURE REVIEW

There are several prior works being discussed in this section. The first study was an implementation of augmented reality systems conducted by Yoga Aprillion Saputra, (2014), entitled "The Implementation of Augmented Reality (AR) in Archaeological Fossils at the Bandung Geological Museum". The second study becoming the reference for the language translation process was conducted by Galih Vidia Pangestika, et al. (2017) entitled "An Android-Based English Language Learning Application for Elementary School Students". The next research was conducted by Mariani, et al. (2017) entitled "The Development of SMS Response and Phone Call Applications Using Android Text To Speech and Proximity Sensors for Drivers" as a reference for the implementation of Text To Speech method (Mariani and Ananta, 2017; Pangestika et al., 2017; Saputra and Indonesia, 2014).

Based on the literature reviews of the previous research, it can be concluded that the creation of an augmented reality-based machine translation that utilizes markerless techniques and Vuforia SDK as a

Nasution, A., Rizki, Y., Nasution, S. and Muhammad, R.
An Augmented Reality Machine Translation Agent.
DOI: 10.5220/0009146301630168
In *Proceedings of the Second International Conference on Science, Engineering and Technology (ICoSET 2019)*, pages 163-168
ISBN: 978-989-758-463-3

supporting library has never been done.

2.1 Machine Translation

There are three different kind of machine translation. The rule-based method is a technique that uses standard language rules in the process of transliteration (Rahman et al., 2014; Dewantara et al., 2013). Hansel (2009) states that statistical machine translation utilizes a machine translation paradigm in which the translation results are generated on the basis of statistical models using parameters obtained from the analysis of the collections of parallel two-language texts. The neural machine translation is a new feature of google translate that works by translating all sentences at once, so the translation looks more natural, accurate and not weird when it is read.

In the research of Nasution, et.al (2017), Machine Translation (MT) is very useful in supporting multicultural communication. Existing Statistical Machine Translation (SMT) which requires high quality and quantity of corpora and Rule-Based Machine Translation (RBMT) which requires bilingual dictionaries, morphological, syntax, and semantic analyzer are scarce for low-resource languages. Due to the lack of language resources, it is difficult to create MT from high-resource languages to low-resource languages like Indonesian ethnic languages. Nevertheless, Indonesian ethnic languages' characteristics motivate us to introduce a Pivot-Based Hybrid Machine Translation (PHMT) by combining SMT and RBMT with Indonesian as a pivot which we further utilize in a multilingual communication support system(Nasution et al., 2017; Panggabean, 2016).

2.2 Pivot-based Hybrid Machine Translation

In the research of Nasution, et.al (2018), Google Translate service and bilingual dictionary service were combined as a composite service in the language grid. There are more than a hundred high-resource languages available in the Google Translate service. To this date, two Indonesian ethnic languages, i.e., Javanese and Sundanese, are available in Google Translate service alongside the official language, Indonesian (Nasution et al., 2018; Nugroho, 2005).

It is unlikely that Google Translate can provide the rest of Indonesian ethnic languages in the near future, since the available corpora for Indonesian ethnic languages are still scarce. In order to bridge the gap between high-resource languages and low-resource languages, in this case between English and Minangkabau, a quicker approach is to create an English-Minangkabau PHMT with Indonesian as the pivot. Since Minangkabau has 61.59% lexical similarity with Indonesian based on ASJP, the morphology and syntax are similar. Therefore, Indonesian-Minangkabau word-to-word translation is expected to be acceptable.

2.3 Language Grid

Toru Ishida (2018) mentioned that globalization increasingly demands multilingual communication on the Internet, as well as in local communities. To create customized collaboration tools to support multilingual communities, the Language Grid was established ten years ago. It has been improving web-based services to communities throughout the world by providing highly adaptable infrastructure and access to a wide variety of language resources and services (Ishida et al., 2018; Nasution et al., 2017; Nasution, 2018).

3 RESEARCH METHOD

3.1 System Overview

Based on the results of the research analysis, it can be concluded that the Augmented reality-based Translating Machine has two criteria. This Augmented reality-based Translating Machine can interact with users by translating text from Indonesian into English and vice versa, and by displaying sound as the result of translation and animated 3D characters. Augmented reality-based Translating Machine is markerless, which means that it does not use printed markers to display 3D animation models.

Figure 1 explains the bird view of process from input in the form of text to output in the form of animation object and speech translation results.

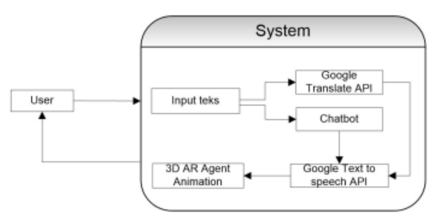

Figure 1: Whole System Overview.

3.2 Interactive Words

Interactive is a matter related to two-way communication or something that is mutually acting, active and interconnected and has reciprocity between one another (Warsita, 2008). In this system, the word "interactive" is classified into two categories, namely special and general. When a user types a word in the application, the word will be matched to the database. If it is in the database, the 3-dimensional character will say an interactive word consisted in a special interactive word table randomly. Otherwise, if the word typed by the user does not exist in the database, the 3-dimensional character will utter an interactive word consisted in a general interactive word table randomly. In this system, the interactive word consists of two languages, Indonesian and English.

Examples of general and specific interactive words can be seen in the following Table 1.

Table 1: Chatbot Corpus

Category	Keywords	#Random Statement
Food	fried rice, meatball, fried chicken, fried potatoes, egg	3 for each keyword
Color	red, yellow, green, blue, white	3 for each keyword
Animal	chicken, goat, cow, cat, dog	3 for each keyword
Transportation	plane, car, motorcycle, bike, train	3 for each keyword
Fruit	grape, apple, banana, mango, pineapple	3 for each keyword
General	None	5

3.3 Flowchart

In this study, the design of the application used a flowchart in order to show the workflow done by the system as a whole. In general, the flows of the application ofAugmented Reality-Based Translating Machine were as follows:

The flow diagram of the application of augmented reality-based Translating Machine can be seen in Figure 2 and Figure 3.

The flows of the system of an interactive machine based on augmented reality can be explained as follows:

1. The user inputs the text.
2. The text is checked in the database.

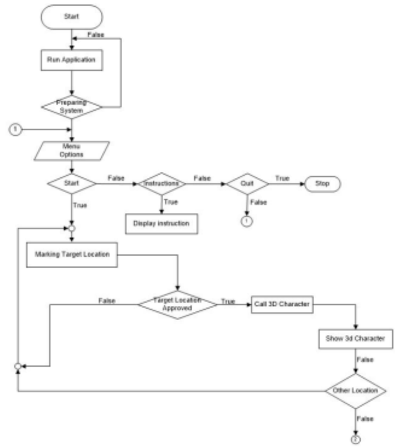

Figure 2: System flowchart (Augmented reality part).

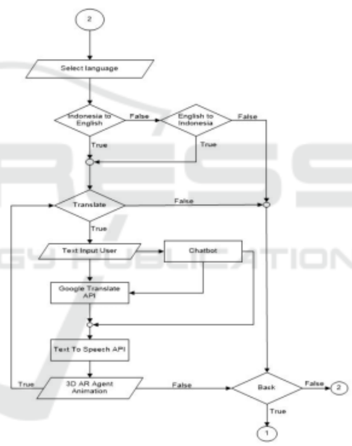

Figure 3: System flowchart (Language translation part).

3. If the text is in a special interactive database, the system would produce an interactive word output in a form of a text.
4. If the text does not exist in a special interactive database in the previous stage, the system would access the general interactive database and generated output from general interactive words in form of text randomly.
5. The output of interactive words is sent to the text to speech API to be changed into sound.
6. Character says the word or sentence to the user as output.

The information about the system flow for the interactive word of Augmented reality-based Translating Machine can be seen in Figure 4.

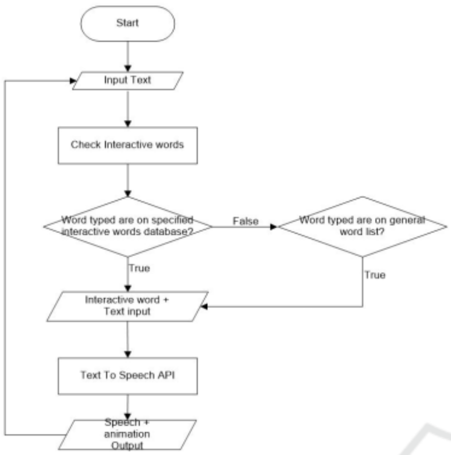

Figure 4: Interactive Word System Flowchart.

3.4 How the Application Works

This Augmented reality-based Translating Machine utilizes a markerless technique, which means that a marker used to display 3D characters has not been registered since the application making. The application will search and mark locations in the camera area as markers, and the location is listed as a marker to display the model of 3D characters. An overview of how the application works can be seen in Figure 5.

4 RESULTS AND DISCUSSION

The following is the interface of the application of augmented reality-based machine translation.

Figure 5: Application Interface

Figure 5(a) is a picture before the user presses the image button and Figure 5(b) is a picture after the user presses the image button.

In this subchapter, we discuss the results of the application testing that has been made. Some of the tests that have been carried out include light intensity testing, viewing angle testing, distance testing, markerless detection location testing, translation testing, and interactive word testing.

4.1 Black Box Testing Scenarios

Black box testing on the application of augmented reality translating machine was conducted to test each function of the interface input in the application, in order to know whether the interface input was in accordance with the expected output. A black box testing result shows that all the system designed match to table 3.1 functionally work as expected.

4.2 Light Intensity Testing

Light intensity testing was conducted inside and outside the room with different light intensities. This test was conducted to find out whether the application of augmented reality translating machine translator could track and display animated models at different light sources.

The conclusion of the test on light intensity can be seen in Table 2.

Table 2: Application test results against light intensity

Test Case	Light Intensity	Wait Time	Result	Test Results
Daytime Outdoor	230 lux	1 Second	3D Character showed	Success
Outdoor Night Day	28 lux	1 Second	3D Character showed	Success
Indoor	1130 lux	1 Second	3D Character showed	Success
Indoor	322 lux	1 Second	3D Character showed	Success
Indoor	0 lux	1 Second	3D Character not showed	Not successful

Based on the results of the light intensity testing in Table 2, it can be concluded that the application of machine translators cannot mark the location or tracking markerless if the light intensity is 0 lux. In other words, the markerless method in Vuforia did not require light even if there was little tracking on the target.

4.3 Distance and Angle Testing

The distance and angle testing was done to find out how far and at what angle the markerless method on Vuforia sdk displayed the 3D characters. This test was carried out with bright light. The test was repeated at a minimum distance of 10cm with an angle of 10°to the farthest distance of 60cm at an angle of 90°.

The results of testing distance and angle of the location can be seen in Table 3.

Table 3: Distance and Angle Testing

Action Testing		Result	Test Results
Distance	Angle		
10 cm	10°	Character 3D showed	Success
	60°	Character 3D showed	Success
	90°	Character 3D showed	Success
20 cm	10°	Character 3D showed	Success
	60°	Character 3D showed	Success
	90°	Character 3D showed	Success
30 cm	10°	Character 3D showed	Success
	60°	Character 3D showed	Success
	90°	Character 3D showed	Success
40 cm	10°	Character 3D showed	Success
	60°	Character 3D showed	Success
	90°	Character 3D showed	Success
50 cm	10°	Character 3D showed	Success
	60°	Character 3D showed	Success
	90°	Character 3D showed	Success
60 cm	10°	Character 3D showed	Success
	60°	Character 3D showed	Success
	90°	Character 3D showed	Success

Based on the data of the test results in Table 3, it can be concluded that with a distance of at least 10cm and an angle of 10, the application of the translating machine is still ableto display 3-dimensional characters well, and the translating machine application is still able to display 3-dimensional characters properly with the furthest distance testing of 60 cm with a taking angle of 60°and 90°.

4.4 Types of Tracking Object Testing

Testing the types of tracking object with the markerless method was carried out to find out the best object or place in marking the location by Vuforia sdk using the markerless technique. This test was carried out with 3 types of objects.

The conclusion of the overall results of testing the types of tracking object can be seen in Table 3. Based on the testing conducted on the tracking object, it can be concluded that Vuforia sdk using the markerless method cannot be used on all tracking object fields as listed in Table 3. It is because if the object lacks of image features, the 3D characters will not appear even though the light and color on the object are sufficient.

4.5 Evaluation

The evaluation was performed by giving questionnaires to 20 people, in order to find out the responses from users about the application of augmented reality-based translating machine. The results of the evaluation after giving questionnaires to 20 respondents can be seen in Table 4.

Table 4: Correspondent Percentage

Correspondent Percentage			
Excellent	Very Good	Good	Not Good
4	15	1	0

Overall, the results of the questionnaire were calculated by using the tabulation formula to get the results of the percentage of each answer to the questionnaire. Each of these percentages is as follows:

1. Excellent : 4/20*100% = 20%
2. Very Good : 15/20*100% = 75%
3. Good : 1/20*100% = 5%
4. Not good : 0/20*100% = 0%

5 CONCLUSIONS

The research and the design of the application of augmented reality-based translating machine have been successfully implemented and a series of tests have been conducted to test the capabilities of the application and the following results are obtained. The application can be used as a reference in learning word pronunciation and translation from English into Indonesian and Indonesian into English. However, it cannot track well if there is no light. It also cannot display the 3-dimensional characters if there are few details on the marker. The minimum distance to obtain good results in displaying 3-dimensional characters is 10cm from the marked location point. At a distance of 60cm with taking angles above 10°to 90°, the application still can display 3-dimensional characters properly. The application can be used both outdoors and indoors.

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