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Augmented Reality Using Text-based Marker for Intermediate Reading Course Modules

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***Abstract*—Reading comprehension in English is very necessary for second-semester students as prospective English teachers. Learning is equipped with independent modules, if finding words in one sentence is difficult to understand in one complete sentence as a result of translation, then a special dictionary is needed. The problem is that it takes time to look up a word in a paper-based printed dictionary. Smartphone-based application development to define difficult words when translated directly needs to be done as a solution to the problem. The developed application must be attractive, efficient, and easy to operate. The steps are analyzing requirements, designing applications, and developing them. Android-based application products have been successfully developed by utilizing the API to recognize letters. Users respond positively to the application developed and meet the expected needs. The application is also able to increase learning motivation with the support of easier word search and definition. Although subject matter experts and users share the same comments on the developed application, it will be discussed further in this article.**

Keywords—AR technology, reading comprehension, deeper understanding, English education, Oxford Learner's Dictionary

I. INTRODUCTION

In teaching English, 4 basic skills will be learned when learning English, including reading, writing, listening, and speaking skills. Harmer also stated that the way we use language is in terms of four skills – reading, writing, speaking and listening [1]. It means that the basic skills in learning English are reading, writing, speaking, and listening. Reading skills underlie the other 3 skills because reading is the first step for students to know and explore the content of the material. Mastering reading skills will make it easier for the 3 other basic skills that students need to master because speaking, writing, and listening skills will be easier to master if students know and understand what will be discussed, written down, and listened.

The Intermediate Reading course focuses on studying how students will develop reading strategies in identifying keywords, analyzing figures of speech, sentences, types of text, improving vocabulary understanding, making conclusions, and understanding articles and short stories. In addition to the material delivered through lectures, students also get a module as a guide for independent study. Modules are learning materials that are systematically designed according to the curriculum and allow students to learn independently within a certain time [2]. However, learning resources that only use modules are deemed insufficient to provide understanding to students when studying independently. Modules are usually packaged in printed or electronic form containing learning materials. Learning modules can function as independent study materials and also as a tool for educators to deliver material so that the modules can assist in increasing understanding.

Understanding sentences in an English text is not easy for learners of English as a foreign language. In addition to being translated word for word and compiled into the local language, the preparation of translated words into a sentence requires certain knowledge. Even though the sentence has been arranged into a sentence that can be understood, sometimes it takes a deeper understanding to interpret it. Understanding each word has an important role because misinterpretation of words will produce different meanings. Thus, it is not enough just to have a general dictionary but a dictionary that contains a broader definition or explanation for it, so that information can be transferred properly.

The only dictionary that provides a definition, explanation of a word is Oxford Learner's Dictionaries (OLD). Oxford University Press (OUP) has sought to bring users closer to a wide range of media options. So far, active English users use printed dictionaries that can be purchased at bookstores. In recent years OLD digital format has been made available, users can access

it for free through the web page (https://www.oxfordlearnersdictionaries.com/) although only in general terms. Even OUP has provided an android-based application that is paid and can be accessed in the play store to be installed on a smartphone. Some of the shortcomings of application-based OLD on Android are that the definitions and explanations are still in foreign languages. In addition, users are required to enter the word they are looking for by typing it into the input field. This deficiency causes students to find it difficult to understand in-depth reading in English.

The first drawback is rarely a complaint because in general OLD is used by users who can translate quite a lot of words without opening a general dictionary. Problems arise when users need to understand more about a word because they have to search in a physical dictionary or type words in a web or android-based application. This is what drives the need to develop tools that can detect text visually and then output a definition of the word. This paper aims to offer solutions to solve students' problems in understanding in-depth an English reading. Development of augmented reality applications using text-based markers with the output of the translation of the definition of the word. The tool developed is only a prototype in a learning event in one module. However, it is important to do this, because the trials carried out and the user's response after the trial can describe the perception of similar applications.

II. Literature Review

Julie Carmigniani and Borko Furht stated that Augmented Reality is a real-time view directly or indirectly of the physical environment (real world) which has been augmented by virtual information created by computers [3]. Augmented Reality is a technology that combines virtual (artificial) objects into the real world that still allows users to see the real environment or surroundings with added virtual objects [4]. It was also stated by Billinghurst [5] that the display on Augmented Reality still allows users to interact with the real world along with the use of virtual objects that are added to the real world. Therefore, Augmented Reality is referred to as a supplement because it only complements reality, not completely replaces real objects. Augmented Reality was developed with two methods, namely Marker Based and Markerless Based Tracking. According to Syahidi et al., the Markerless method is a pattern that relates to the object directly, unlike Marker Based which is a box-shaped pattern with a black frame inside which is made like barcodes, QR codes, or other printed patterns [6]. Face tracking, 3D object tracking, motion tracking, GPS tracking, gyroscopes, electromagnetic compass or anything without vision-based tracking are also Augmented Reality technologies that use the Markerless Based method [7]. This method minimizes a marker such as a square black and white illustration with a thick black border and white background. Tracking, sensing, display, and interaction are some of the typical tasks that must be carried out by an AR system, as shown in Fig 1. Independent development can be done through fast prototyping frameworks of the AR system application. Vuforia SDK, MetaIO, ARToolkit, OpenCV, and Kinect are some of the frameworks that can be used for easy integration of AR devices and their user interfaces.

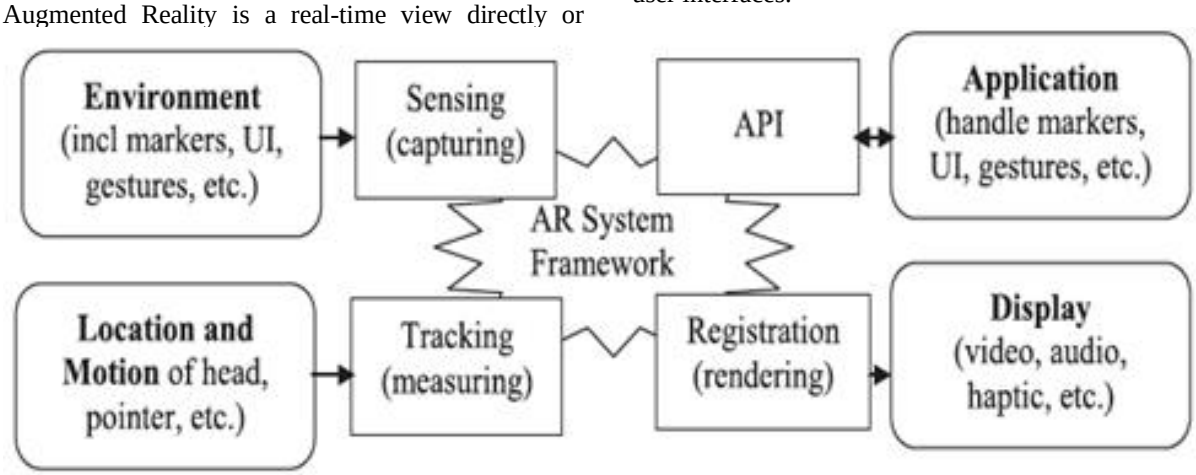

Fig.1 Typical AR system framework task

In general, augmented reality translation applications are developed with the main components, namely text detection, text extraction, and text translation. These components also represent the steps in the process of the application. The first step is to detect text in the real world in real-time to classify text fields from non-text fields. Everything is done automatically, quickly, and accurately. The second step is text extraction and recognizing the detected text to process it. Existing Optical Character Recognition (OCR) can be used to achieve this. Some OCRs that have been widely used are Tesseract, ABBYY, and Google mobile vision API. The extracted text is then translated as the final step. This can also be achieved using the translation API i.e. Google and Microsoft translation. Some of the same work has been done over

the past decade. The difference lies in the method, the translated language, and the detected object. The focus of the article discussed here is an augmented reality application using text as an object that is detected to align with what we are working on. The presentation is arranged for 2011-2019.

Du & Sun has developed a prototype for Windows Phone 7 called "Snap and Translate". The selection of the translated text is user intervention, either tap, swipe, or circle. The application was developed to translate words or phrases in English into Chinese or vice versa [8]. Fragoso, et al also developed a semi-automatic translator, there is still user intervention. Applications developed based on OS Maemo (Linux-based) implemented on the Nokia N900. The language translation is not explained but the translation service uses Google Translate [9]. Petter, Fragoso, and Baur improved upon their previous work of automatic text detection. Development of suitable algorithms for Augmented Reality translation systems on mobile phones with an average speed of up to 160ms translation process [10]. Parhizkar, et al proposed an application to translate language into English. The proposed application is to capture words and translate them into English in any place, anywhere, and anytime so that they are ubiquitous [11]. Arioputra and Lin developed an application that translates Chinese sign text menus into English menu names and 3D models. An Android-based application with the development of 3D food models using the Unity 3D game engine [12]. Rose and Bhuvaneswari developed AR software from English text to Tamil. An Android platform application using the Vuforia data set library and developed with Unity 3D 5.1.3 software [13]. The software has been tested with up to 90% accuracy, even under normal or uneven lighting conditions.

Syahidi et al. developed an Android-based BandoAR application. Augmented Reality application that translates Banjarese into Indonesian with an emphasis on detection and tracer text processes. The application was tested by 160 respondents with the results of the responses being interested in using and can be applied in real life [6]. Ibad et., al have developed an augmented reality application using text detection to improve understanding of the network technology lecture module. Improved understanding is achieved through finding the equivalent words in the module. The process is one word that is captured from the output module, several words can replace the word [14]. Nurzam and Luthfi is an Android-based augmented reality application to translate from Indonesian to Javanese. The development involves Google Mobile Vision as an open API optical character recognition library with a pattern recognition method. The android application is designed in a client-server architecture, where the application is a client and web service that processes the REST API and interacts with the database [15]. Soogund and Joseph developed an Augmented Reality application to help hearing-impaired students understand English reading. The translation process occurs when the word is caught on the phone camera, then sign animation appears on the phone screen. This application is useful for hearing impaired students who are learning English, as well as hearing students who are learning sign language using English [16].

III. METHOD

The product development steps are analyzing and assessing needs, designing applications, and developing them. The activity is continued with self-appraisal or self-assessment before the Expert Appraisal is carried out. Expert Appreciation is carried out until the product is declared valid and proceeds to the development testing step or product testing by users. The experts involved are media experts and subject matter experts using instruments. The instrument used was a response questionnaire containing positive statements.

The response questionnaire for media experts consisted of forty-six statements with a grid consisting of seven aspects, namely aspects of the quality of utilization instructions, completeness of utilization procedures, utilization, display design, attractiveness, typography, and technical quality. For material experts, there are thirty statements with a grid consisting of six aspects, namely aspects of the quality of the instructions for use, relevance, scope and depth of the material, accuracy, suitability of presentation with learning demands, and utilization procedures. Development Testing, namely conducting product development trials by eight students of the second-semester English teacher candidates.

Product trials are carried out at the same time after independent learning using the module. The instrument used was a response questionnaire for students consisting of twenty statements with a grid consisting of three aspects including attractiveness, efficiency, and convenience. All questionnaires were developed to collect participant response data using a rating scale from 1 – 4 (1-very disagree, 2-disagree, 3-agree, 4-strongly agree). Response data were collected based on participants. The data were processed quantitatively descriptively and presented in tabular form for further discussion.

IV. RESULT AND DISCUSSION

Augmented Reality development of the Intermediate Reading module means an application that functions as a definition dictionary but is very different from how it works. In general, electronic dictionaries still need time to type words in the search field or look up each word individually in offline or paper-based dictionaries. Meanwhile, this technology only requires a smartphone camera with an automatic focus for capturing text and displaying the definition of the captured word. Technically, the system in the Augmented Reality application detects the pattern that

has been made, which is in the form of text that has been marked on the Intermediate Reading module. The pattern serves as a marker that will be recognized through the smartphone camera. Fig 2 shows the appearance of an application on a smartphone that is being used to define marked words on a computer monitor screen.

The application runs smoothly on almost all Android-based smartphones that feature autofocus. The time it takes for a process from detecting text to translating its definition depends on the camera quality, smartphone positioning, available memory space, and processor speed. The background color of the detected word has no effect at all, even though the text color is almost 50% similar to the background. Only when the text is a bit blurry or 50% of normal conditions, word detection is less accurate. The text detection process consumes longer time than the translation process, because it is related to the condition of the text and the autofocus process from the camera (different) on an object.

Fig.2. Text-based Marker Capture Display

Table 1 represents the results of the subject matter expert's response analysis with aspects that need to be assessed from the product being tested. In general, the subject matter expert's response to the product is considered valid for use at a later stage with an average of 3.6, a standard deviation of 0.14. The highest average is 3.8 on the aspect of conformity with the definition indicator to facilitate learning, understanding reading, fostering activeness, complete learning, and easy-to-understand definitions. The relevance aspect obtained the lowest average response of 3.4 because the indicators of students mastering the definition, the completeness, and accuracy of the definition were responded to only agree. This is also reflected in the suggestions and comments stating "the definition should be completed as in the Oxford Learner's Dictionary because it is necessary for students studying the intermediate reading course". We are fully aware of this so that it is not complete in presenting it, because there are limitations on the use of OLD related to copyright and licenses.

TABLE I. ANALYSIS RESULT OF SUBJECT MATTER EXPERT RESPONSE

Aspect	Mean
Quality user manual	3.7
Relevance	3.4
Scope	3.5
Accuracy	3.6
Suitability	3.8
Utilization Procedure	3.6

Media experts gave overall responses to the aspects presented in Table 2 with an average of 3.9, a standard deviation of 0.16. These results indicate that the media is valid to be used for further trials. The aspect with the lowest average is the completeness of the utilization procedure of 3.6 in the point of utilization instructions containing clarity on the implementation of activities and the application item containing reinforcement and feedback. This is reasonable because the application is only used when needed (just in time learning) [14], not directly involved in full learning or known as the Electronic Performance Support System (EPSS) [17]. Table 3 presents an analysis of user responses to augmented reality applications when used in learning with modules. Users responded positively to the developed application with an average of all aspects of 3.6. This shows that users are interested in using the application, because of its ease of use and efficiently improving learning performance.

TABLE II. ANALYSIS RESULT OF MEDIA EXPERT RESPONSE

Aspect	Mean
Quality user manual	4
Completeness user manual	3.6
Utilization	4
Interface design	4
Attractiveness	3.75
Typography	4
Technical quality	4

The attractiveness aspect is the aspect that determines the continuous use of the application. The highest average of 3.9 on the statement item "application makes me more enthusiastic in learning". This shows that according to users, the use of the application is able to foster learning motivation. The lowest average is 3.4 on the statement item "continuous use of the application to seek definitions". Users feel that the application meets the needs of the definition but some things need to be completed concerning the characteristics of the course. This is in line with the advice of material experts who give the same opinion. In line with previously developed applications augmented reality translators are attractive to users.

TABLE III. ANALYSIS RESULT USER RESPONSE

Aspect	Mean
Attractiveness	3.6
Efficiency	3.6
Easiness	3.6

The efficiency aspect refers to the time required to complete the work, in other words, the application is able to support student learning performance. All users agree that the application is able to quickly look up the definition of a word rather than looking it up in a printed dictionary. This is shown in the highest average obtained, which is 4. Contrary to the statement item that "application helps find definitions faster" it obtains the lowest average (3.4). Users assume that not all words have neither the desired definition nor the available definitions are not sufficient to provide more understanding of a sentence. This aspect has never been asked for feedback on the development of applications that function the same, so it can be used as a reference that augmented reality applications are able to support the completion of other work efficiently. The statement item “clear instructions for use and easy operation” on the aspect of ease of obtaining the highest average response (3.9). These responses support responses from subject matter and media experts. The lowest average response (3.4) in this aspect is the statement item "the use of text-based markers makes it easier to find definitions". The low user response to the statement can mean that users need more speed in detecting text-based markers. Even users are more comfortable without markers and all words are defined. Aspects of ease for users to respond well are also found in applications that have the same function [6], [18].

V. CONCLUSION

The development of augmented reality applications using text-based markers has been successfully carried out. There were no errors or problems during the trial to all participants. All text that is used as a marker on the module can be detected properly and quickly thanks to the support of the API which is always improving in detecting and providing libraries. Media and material experts responded positively to the application trial, although some suggestions from material experts needed more attention regarding the completeness of the output of text detection results. Users also give positive responses to the applications that have been developed. The attractiveness aspect of the application received the highest response by users which was also found in applications with the same function. Likewise, the ease of use of the application received positive responses from users. Based on user feedback on the efficiency aspect, the application is able to support module-based learning performance for reading comprehension in the intermediate reading course. In the future, augmented reality technology that functions as a translator (similar) has the opportunity to contribute in the field of education and learning, especially reading comprehension. It does not specifically refer to anything to do with language but difficult to understand words found in every book, course note, or module in any subject or course. Thus the application needs to be developed and continued in a direction that can help improve learning performance.

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