Mobile-based Augmented Reality for Historic Building Lessons in West Java

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Abstract—Learning media is currently important in education at the elementary and higher education level. Teacher should choose the right learning media with a good curriculum for students. Current technology can be utilized to support learning media. New education material, such as video or audio can be added. One kind of learnings that can be delivered with the video and audio media is about historic building. Historic buildings are cultural and historic heritage that must be preserved for the need for students to find information about historic buildings, names, locations and their historic story. The study proposed the mobile-based learning media of historic building. The development method used in this study was Rapid Application Development (RAD). A blueprint for learning media of historic buildings in west Java in this study might help the local governments to share historic buildings.

Keywords— Historic Buildings, Learning Media, Rapid Application Development (RAD)

I. INTRODUCTION

West Java Province is a steep mountainous regions in the south with an altitude of more than 1,500 meters above sea level, sloping hillside areas in the middle with an altitude of 0-10 meters above sea level, and watershed areas. West Java is located in the east of Jakarta Metropolitan Region (JMR). The population of West Java is the largest population in Indonesia of approximately 46.37 million people; the population growth rate reaches 1.43 percent. Most of the population in West Java are active students who are studying in elementary schools which are spread in several cities in West Java. The total area of West Java is 35,377.76 km^2, with 27 Regencies/Cities with some historic buildings around this area [1].

Historic buildings are houses and infrastructure have been built for a long time ago in a region that usually in different government. The advancement of a nation's civilization can be seen through the building techniques as well as the facilities and infrastructure. Therefore, historic building is a cultural and historic heritage that must be preserved. Students must know more about information about the historic building in the form, name, location and history of the building being erected. Most historic subjects have been taught in the school are only in the form of text materials without direct. Therefore, the students are not interested in knowing more about the building.

Previous research on mathematics experienced the same situation. This obstacle should be realized by the teacher to reduce the uninterested problem or even turned into interesting learning [2].

A similar study has also been done on Umbara Trans, a travel service provider company with a range of areas from Jakarta to Bandung. Several new travel service providers makes Umbara Trans must respond for the competition. Therefore, it was necessary to improve the strategy in the business in order to improve service and user satisfaction. Based on the results of interviews and questionnaires to staff and members of Umbara Trans, it was known that the necessary improvements in the form of innovation are the promotion process, information dissemination, ticket booking and sales that are easily accessed by service users, anytime and anywhere, and a computerized system that makes it easy for Trans Umbara parties in monitor ticket sales more neatly and can be justified. A solution was proposed in the form of implementing travel ticket m-commers on Android smartphones developed with the RAD (Rapid Application Development) and UML (Unified Modeling Language) methodology as a tool in system development. This research resulted in the M-Commerce Travel Ticket application on a client-server-based Android Smartphone, where on the server side the application was built in the form of a website using the PHP programming language and MySQL for data input and database management processes. While on the client side a mobile application that runs on an Android smartphone that is used by members to access information (schedule, fleet, location of the closest pool and ticket prices), promotions, bookings and travel ticket purchases [3].

Augmented Reality (AR) and Virtual Reality (VR) have been widely used as a the learning media for education [4]–

[12]. Most studies have reported the success of AR implementation for elementary, middle and high school students [5], [13]–[16]. The selection of appropriate and effective media can make a positive impact on students, i.e. a student achievement. Learning material is the main key in explaining the material that will be delivered with appropriate learning media and an interactive class should be achieved.

The above studies have successfully implemented the AR technology through mobile and web-based platform. In the current study, we proposed a new AR-based learning media by integrating with some free applications, i.e. Google Street View and VR-based Youtube channel for a learning media of historic buildings lesson in West Java, Indonesia. The paper contributes to the new insight for developer, teacher, and others who want to design learning material for historic building in elementary school.

II. DATA AND METHODS

A. Learning Media

Learning medias are tools used by educators to convey learning materials. These tools are often referred to as props that serve student and teacher in the educational process. The more sensing used to accept something, the more clearly the knowledge gained. A prop usually uses as many senses as possible to a learning object. Some benefits of props use, namely, (1) create educational interest, (2) achieve more goals, (3) helping teacher to overcome language barriers, (4) helping the student to achieve a target education more quickly, (5) encouraging the educational goals to pass on messages received to others, (6) facilitating the delivery of learning materials by educators or teachers, and (7) making it easy to receive information by educational goals.

Previous study by on learning sensing, the most knowledge-based channel in the brain is the eyes. Approximately 75% to 87% of human knowledge is acquired through the eyes. Whereas 13% to 25% is transmitted through other senses. It can be concluded that visual tools make it easier to present and receive information or learning materials.

According to the terminology literature, the media comes from the Latin "medium" which means intermediaries while in Arabic the media comes from the word "*wasaaila*" meaning the introduction of the message from the sender to the recipient of the message. Learning media can also be defined, by Martin and Briggs (1986), as media in which all the resources are needed to communicate; this can be in the form of hardware and software [4].

The learning media always follow the technology development, ranging from print technology, audio visual technology, computers to the combined technology of print technology with computers. Nowadays, the learning media combined from print and computer technology can be realized through Augmented Reality (AR) technology. It is a technology that realizes a virtual world into the real world in real-time. For example, when learning the human digestive organs. Human digestive organs consist of the mouth, esophagus, stomach, small intestine, and large intestine. Usually it represents through very monotonous media, i.e. through pictures, books or even other projection devices. Using Augmented Reality, it can be presented by virtual world in which the 3D objects are presented. Therefore, this learning method is interesting and the children are encouraged to find out more, such as knowing the names of organs and information from each of these organs [17].

B. Heritage Objects

A Cultural Heritage Property is a man-made, movable or immovable object in a unit or group, or parts or remnants, which are at least fifty years old, or represent a unique style period and represent a style period of at least at least fifty years, and are considered to have important value, science, and culture, as well as the natural objects that are considered to have important value for history, science, and culture. The Site is a location that contains or is suspected to contain objects of cultural heritage including the environment required for its security according to act number 5/1992. In Indonesia regulation No. 11 of 2010, Cultural Heritage is material cultural heritage in the form of Cultural Heritage Objects, Cultural Heritage Buildings, Cultural Heritage Structures, Cultural Heritage Sites, and Cultural Heritage Areas on land and/or in water that need to be preserved because they have important values for history, science, education, religion, and/or culture through the process of determination.

C. Historic Buildings

Historic buildings are houses, or infrastructure that are built many years ago and have a valid historic information about the purpose of the construction. The rapid advancement of a nation's civilization can be seen from the building techniques as well as the facilities and infrastructure used to build its civilization. The historic building is a cultural and historic heritage that must be preserved. Therefore, students have to know more about information about the historic building in the form, name, location and history of the building being erected. Most historic subjects are taught in the school without a proper interaction with the material, for example historic buildings so students are not interested in knowing more about the building.

D. Rapid Application Development

According to Kendall in [18], a Rapid Application Development (RAD) is an object-oriented approach to system development which includes a development method and software. This is a modern methodology to quickly develop a software [19].

Fig 1 shows the RAD framework used in this study. First phase of this framework is requirements planning. This phase collects the information about what the system do based on the user perspective. Data collection activities are done in this phase. Both functional and non-functional requirements should be gathered. After all the important requirements have been collected, design workshop phase is carried on.

E. Proposed Framework

Three data collection methods were used in this study, i.e. observation, interview, literature study to get the information about the historic building in the study area. In addition, after creating the blueprint of the learning media, the questionnaire was sent to the potential users.
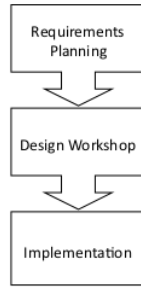
Fig. 1. RAD Framework

The study used RAD framework with an addition on survey about the proposed blueprint acceptance. Fig 2 shows research framework of the current study.
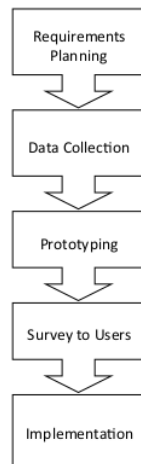

Fig. 2. Research Framework

After requirements and data collection, a prototyping phase should be done. Software for developing the proposed AR were vuforia, Unity and Blender. Vuforia is a powerful application developed to support the creation of Augmented Reality. With form of Software Development Kit (SDK), vuforia has the ability to do image recognition in the development of image recognition. There are two types of database workflows that developers can choose, i.e. the Cloud Database and Device Database. Unity Game Engine is not only a game engine, but also an editor. With the SDK developed by Vuforia for Unity, the Unity 3D application allows it to be used as an engine to make Augmented Reality [17](Fig 3 and Fig 4).

Fig. 3. Proposed Learning Media

The system architecture which was built using the Vuforia SDK in Vuforia SDK required several important components in order to work properly, including: (1) Camera, needed to ensure that each frame is captured and efficiently transmitted to the tracker. (2) Image Converter, converts camera formats (for example YUV12) into formats that can be detected by OpenGL (for example RGB565) and for tracking (for example luminance). (3) Tracker, contains a computer vision algorithm that can detect and track real-world objects that are on the video camera [17].

To view the location with 3D location, the Google Street View link was provided. This aid the learners if they want to go to a particular historic-building. If a learner want to see the 3D view inside the historic building, a VR link from a Youtube channel was provided. Fig 4 shows the Google Street View of a historic building (Candi Cangkuang).

Fig. 4. Google Street View Links of a Historic Building

Survey to the potential users was done with the Questionnaires regarding the acceptability of the proposed learning media. Table I shows the assessment aspects of questionnaire.

TABLE I.   ASSESSMENT QUESTION IN QUESTIONNAIRE

No	Assessment Aspects
1.	Is the 3D visualization interesting?
2.	Colour Presentation
3.	Font Presentation
4.	Font Size
5.	Text and Picture Layout
6.	3D picture
7.	Font Appearance
8.	Text and Picture Appropriateness
9.	The Sound Quality of Presentation
10.	Time Duration for Each Section

III. RESULT AND DISCUSSION

Fig 5 shows the activity diagram for gathering the requirements of the proposed application. In the first main menu there was a camera AR menu selection which presents interaction between objects and learning media. The second selection was the museum which contains a collection of museums in the study area. The third selection was building which contains a collection of historic buildings and temples. This phase consists of visualization of the learning media to be designed including: Activity Diagram and User Interface

Design for historic building learning media in West Java. For each category a user can see the exact historic building through VR-based Youtube channel and Google Street View links.
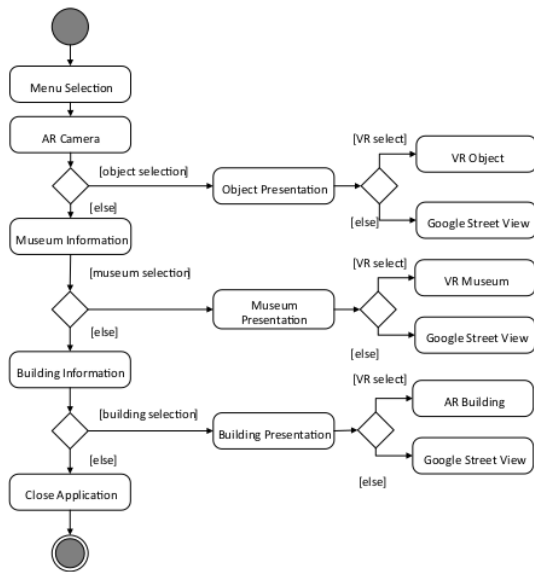

Fig. 5. Activity Diagram of Historic Building Learning Design

Table II shows the detail information for each menu. There are two to four information for each menu selection that might be added if necessary. These categories should be presented in mobile-based application shown in Fig 6 and 7. Indonesian language was chosen for the application following the background of the users. Each information in "Detail Informatin" Column in table II should be linked to Google Street View and VR-based Youtube channel.

TABLE II.   CATEGORY OF HISTORIC BUILDINGS IN WEST JAVA

No	Category	Detail Information
1.	Temple	a. Cangkuang Temple
	b.	Karangkamulyan Site
	c.	Padang Mountain Site
	d.	Jiwa Temple
2.	Museum	a. Palagan Bojong Kokosan Museum
	b.	Bogor Zoologi Museum

No	Category	Detail Information
3.	Building	a. Bogor Palace
		b. Bosscha Observatory
		c. Bank Indonesia Cirebon
		d. Kidnapping House of Soekarno Hatta

Fig 6 shows the user interface that contains four menus in Indonesian language, i.e. "*AR Kamera*", "*Museum*", "*Gedung*", and "*Candi*".
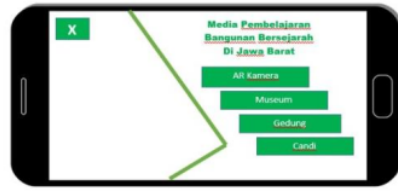

Fig. 6. User Interface Media Design of Historic Buildings in West Java

Fig 7 shows after the building menu execution which contains four learnings in Indonesian language, i.e. "*Istana Bogor*, "*Observatorium Bosscha*", "*Gedung Bank Indonesia Cirebon*", and "*Rumah Penculikan Soekarno-Hatta*".

Fig. 7. Building Menu User Interface Design

Similar appearance was created for other menus. For the AR camera, a virtual reality glasses were needed. The AR Camera menu was connected to the camera on a smartphone or device that has the AR application installed (Fig 9). The camera was used for marking and producing objects for, e.g. the Boscha building in Bandung, West Java.

Fig. 8. Main Application Page Interface.

On the main page, learning media applications used Augmented Reality technology and there are 4 menus for each function.

Fig. 9. AR Camera

Before implementation a survey to the potential users have been done with the result as shown in Fig 10 with 5 scale Likert, i.e. Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree. All the respondents are elementary teachers with the average age of 42 and male and female composition of 78.6% and 21.4%, respectively.
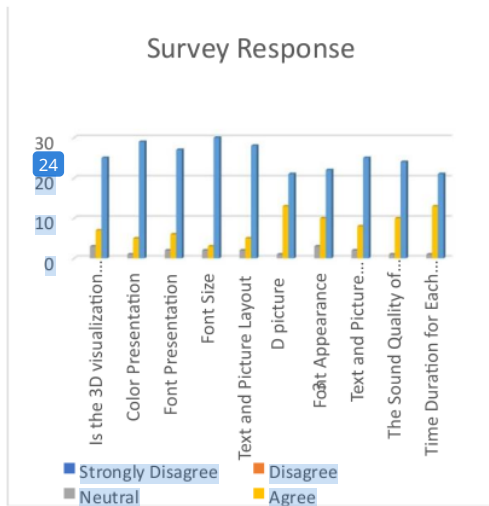
Fig. 10. Survey Response of the proposed AR.

Most respondents agree with the proposed mobile-based system for learning media. Therefore, it can be implemented for android as well as other platforms.

IV. CONCLUSIONS

Result indicated that the proposed learning media is a good tool in teaching and learning, especially for the historic buildings education. Teachers can more easily convey material about historic buildings in West Java and students can interactively learn about the subject. Based on the survey, the proposed interactive learning media is adequate for implementation. The Augmented Reality-based learning media should be included to get the optimum learning outcome.

REFERENCES

[1] BPS Provinsi Jawa Barat, "Provinsi Jawa Barat dalam Angka 2017," p. 718, 2017.

[2] A. Suharso, "MODEL PEMBELAJARAN INTERAKTIF BANGUN RUANG 3D BERBASIS AUGMENTED REALITY," *Solusi*, vol. 11, no. 24, pp. 1–11, 2012.

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