



Development of Newmedia for Efectivity Instructional Communication

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Abstract

Biological abstract concept often becomes obstacles for students in understanding the material so that the mastery of learning material is not completed. One way to present whether the information is difficult or not, such as the internal organ of the body, is to make it into student worksheet with a marker that is combined with Augmented Reality technology, which helps students in understanding the internal organ of human body. The method of this research is using The ADDIE model has been used as a research methodology. In this model, there are five main phases of analysis (A), design (D), development (D), implementation (I) and evaluation (E). The trial in this study is using emulator, mobile device, and questionnaire. The subjects of this research are high school students of class XI. This development research results showed the student worksheet-based mobile application using Augmented Reality technology can increase student interest in studying biological materials at the high school level.

Keywords: Component; Augmented Reality; Students Worksheet

Introduction

In this modern era, learning can be obtained in numerous ways because of the advancement of technology. Nowadays, technology has been innovated to come out from the traditional learning approaches. It brings a new way of learning, especially through communication and information technology. The influence of communication and information technology can be experienced on education field, it changes the *face-to-face* or conventional way to media which can be accessed every time. As a result, learning now can be very efficient to be accomplished. The new technology of internet, the nature e-learning is being developed. E-learning is a conventional learning which is formed in digital format through internet technology. It can be accessed for distant learning depends on its importance. Berman (2006: 1) stated that e-learning is a means of education that incorporates self-motivation, communication, efficiency, and technology. E-learning is efficient as it eliminates distances and subsequent commutes. Distance is eliminated because the e-learning content is designed with media that can be accessed from properly equipped computer terminals, and other means of Internet accessible technology. E-learning is a flexible term used to describing a means of teaching through technology. Based on the statement above, e-learning is very beneficial because it facilitates individuals to learn effectively and builds individuals' self-knowledge and self-confidence.

The differences between traditional learning approaches and e-learning are the learning method judges the classroom teachers as the master of the lesson and they have responsibility to deliver the material of knowledge the students in the classroom. So, the students must perform the lesson based on teachers' instructions. On the other hand, e-learning forces the students to perform their needs independently and individually. The students have to be more active in using e-learning and be responsible with their own learning. E-learning is designed as if the students face to face with the instructors in the dimension room with computer, Smartphone or gadget connected and linked to internet connection which is easy to be used.

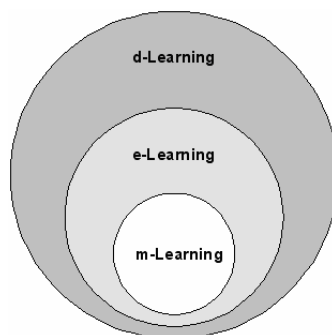
There are various topics which can be created on e-learning. Also, there are many activities which can be applied to many different learning styles individuals have. Londen and Maciniak (2009:10) argued that the content of e-learning courses should be communicated using different media including text, voice and sound. The efficiency of training directly depends not only on the quality of training materials but also on interesting and stimulating presentations. E-learning courses are characterized by a number of functionalities making it possible to exchange learning materials, do tests, communicate with each other in many ways, track and trace the progress, etc. The ADDIE model is a generic instructional design model. It provides guidance at a fairly high level for instructional designers, software engineers, the ADDIE model is an iterative feedback model, which means that the results of the Evaluation phase are returned to the origination point (fed back), closing the loop, facilitating further refinement of the learning product. If the evaluation shows that the module has shortcomings, for example, that the objectives of the module do not align with organizational objectives, those shortcomings are returned to be analyzed again. [16:2007] Information and communication technologies developed in line with the development of theories, communication, and technologies that support learning in practice. E-learning, computer based learning or utilization of audio-visual is one form of utilization of information and communication technologies. One medium that allows the learning process more fun and no longer static is to utilize Augmented Reality (AR) which is made as a student worksheet. As stated As mentioned by the Emerging Technology Entering century information and communication technologies, the need of the importance of the use of ICT in the learning process cannot be avoided anymore. The learning process is still going on nowadays is the conventional method with static teaching materials such as books or modules, and teaching materials are not able to show the motion because it is static. Integration of ICT in the learning process may be more fun and learning is not static anymore.

Initiatives of New Media Consortium (NMC) in the most recent Horizon Reports (NMC 2010, 2011 and 2012), Augmented Reality (AR) is one of the emerging technologies that might have potential and impact on learning and education. In addition, the emergence of android-based mobile phone device that has many familiar and among students is encouraged integration mobile devices for the sake of learning, development especially media student worksheets based augmented reality. In the research where A total of 62 learners were assigned to the VR mode while 64 learners were assigned to the Non VR mode shown that that learners exposed to the VR mode obtained significantly higher gain score for the VR based test than learners exposed to the Non VR mode. The significant positive effects of the VR based learning environment (referring to the VR mode) on learning when compared with the Non VR. Mode provides another evidence of the potentials of VR technology for instructional use. This VR based learning environment provides new learning opportunities by introducing learning activities that make visible concepts and relationships that are not easily grasped or visualized by learners when relying only on the conventional method (2006:11).

An AR mobile application has been designed and developed in this study in order to identify students' perceptions in learning complex materials in a computer science course. This application was implemented to 24 second year students who took computer organization and operating system course. Results of the evaluation showed that most of the students were motivated to use AR in learning (15:2015).

Mobile Learning

The term of mobile learning (m-learning) refers to the utilization of Information and Communications Technology Device which can be handled and moved, like PDA, mobile phones, tablet PC, and computers.[Wood, 2005]. M-learning is a unique learning because learners can access the materials, referrals and applications related to “anytime” and “anywhere” learning. This will increase the attention of learning materials, make learning becomes pervasive, and can encourage learners motivation to lifelong learning. Furthermore, compared to conventional learning, m-learning allows more opportunities for collaboration in ad hoc and informal interaction among learners [Holzinger et al, 2005]. In e-learning, independent of time and place is an important factor that is often emphasized. However, in traditional e-learning, the minimum need is a PC thus has a consequence that the independent of time and place are not fully fulfilled. This independence still cannot be fulfilled with the utilization of notebook (portable computers), because of the independence of time and place that actually means one can learn anytime and anywhere he or she needs to access the learning material [Holzinger et al, 2005]. Structurally, m-learning is part of e-learning so that, by itself, is also part of d-learning (distance learning).



Although it has some advantages, m-learning will not completely replace the traditional e-learning. With limited computing resources, m-learning cannot provide and / or access the same learning resources together with the existing resources on e-learning. The available resources in m-learning will be very likely to be used as a supplement to e-learning as well as for traditional learning environment where aided learning computer is not available [Holzinger et al, 2005].Meanwhile, the m-learning user’s characteristics themselves are quite varied. Users who are familiar with the use of a PC (personal computer) as a learning media turned out rather keep using PC, while those who are not familiar with PC feel that mobile device is more attractive and more acceptable [Virvon, 2004]. The optimal system is combining m-learning with e-learning, where there is an alternative learning process is done with computers and / or mobile device [Holzinger et al, 2005] or in combination with traditional learning system.

Augmented Reality

According to Ronald T. Azuma (1997), augmented reality is to combine the real and virtual worlds, interactive in real time, and a 3D animation. Teachers who are creative and innovative has always tried to develop learning strategies by using creative media, one of the examples develop student worksheet-based augmented reality, as proposed by John Smith, Willis, Levine and Haywood (2011) they found augmented reality is one of the new technologies that are considered to have potential for learning applications. Zhou, Duh and Billinghamurst (2008) defines definition augementer reality AR based on its

features the which the real and computer-generated information are combined in a physical world, interactively in real time, and display virtual object Intrinsically align to real-world orientation.

In 1975 a scientist named Myron Krueger found Video place that allows users, can interact with virtual objects for the first time. In 1989, Jaron Lanier, introduced Virtual Reality and created the first commercial business in cyberspace, in 1992 to develop Augmented Reality to perform repaired on Boeing aircraft, and in the same year, LB Rosenberg developed one of the functions of the AR system, called Virtual Fixtures , which was used in the US Air Force Armstrong Labs, and showed its benefits for humans, and also in 1992, Steven Feiner, Blair MacIntyre and Dorée Seligmann, introduced Major Paper for Prototype development of AR for the first time. In 1994, Milgram and Kishino formulated frameworks and smelting possibility of merging the real world and the virtual world into a continuum of virtually. Variuos fields such as military, health, education and other fields of applied science which has been implemented as part of augmented reality technology in its environment. Using augmented reality technology is expected to application users will feel the direct interaction process.(12:2011)

AR technology was born after virtual reality technology. Virtual reality replaces reality with a simulation. On the other hand, in AR technology, a view of a reality can be modified by addition of digital information so that it can improve a person's perception of the reality. In AR, there are four main components: (1) a camera to capture a target information, (2) marker which is the target information, (3) mobile phones to store and process information when the captured image is the target information (marker), and (4) digital content is the content that will be displayed on the screen when the camera is able to track the marker. The use of AR technology has also received positive feedback from participants and students who have shown their interest in using AR in their learning processes. These good responses are important because they indicate the willingness of students to actively engage in their studies through AR tools (13:2015). Most children mentioned events of interactive sequences when we asked them what they liked best. Although the children had difficulties verbalizing their experiences, a lot of them also referred to the system and augmented book itself. [14:2007]. Currently the use of hand phone is widespread among students along with the use of Smartphone and tablets, mobile phones can be used for a variety of activities, including learning. Some research have been conducted and concluded that the mobile device has its advantages and its impact in education perspective.

Marker Based Tracking

Augmented Reality presents the information in a real-world context (reality). In order to do this, the system needs to know where the user is located and what would be detected. Normally, the users explore the environment through the camera screen which portrays an augmented information. So in practice, the system needs to determine the location and the camera orientation. In the visual tracking, the system will conclude the camera pose based on observation of what they saw on the marker. It takes some time to collect enough data to be able to conclude a pose and then calculate the pose estimation. As an unknown environment by the system, the system will choose a random orientation of the coordinate axes.

Marker Detection

There are 3 stages in the process of reading camera marker. The first stage, the camera shot the marker directly. The second stage, the marker is converted into black and white binary. After that, the toolkit find boxed black pictures and match with the memory template in the toolkit, if the marker is declared fit, then the toolkit will use the introduction of the boxes and orient the marker to calculate the position of a real camera with a real marker, as it 3x4 matrix will be filled when the real camera coordinates the marker, this matrix will be used to adjust the position of the virtual camera. In the third

stage, when the coordinates of the virtual camera and real camera are same, then the computer graphics will draw and overlay 3D marker objects which has good quality will be easily detected in all situations. A difference in lighting (brightness) is relatively easier to detect than the difference in color (chrominance). This is due to automatic white balance of the camera may cause contrast intensity marker detected that will affect the process of collecting data on the marker.

Pre-Processing

Before the actual detection, the detector system must obtain an image (intensity of a gray scale image). If the captured image is an image with another format, the system will convert it to change, for example, an RGB image is converted into an intensity image using a technique so that it becomes an image with gray scale format. The first task of the detector process is to find the potential limits marker. The detection system uses two approaches: either records the threshold image and finds the signs of a binary image, or by detecting the edge of a gray scale image. This is the low level task image-processing (thresholding, edge detection, fitting line, etc.).

Application Overview

Augmented Reality Application for Human Body Organ is an application that presents information that obtained from the subject of biology for Senior High level Grade 10 with the subject of structure and organ function in the human body, which is then presented in the form of three-dimensional object information (3D) and video which using the technology of augmented reality. To implement the augmented reality technology and material in the human body organ is to use a marker that is used as a target image which can display digital information in the form of text, three-dimensional object and video. Then, this marker will be made into a book which is called the Magic Book as an educational tool to learn about the motion system in human. How the application works is the user has already had Augmented Reality Application for Human Body Organ, then select the learning materials menu which is desired, point the camera on Android based mobile device to the one picture (marker) that exist in the magic book, then this app will detect the marker, after the marker is detected it will show the object in the form of text, images, three dimensions object (3D), and video that can be processed interactively.

Research Methods

The ADDIE model has been used as a research methodology. In this model, there are five main phases of analysis (A), design (D), development (D), implementation (I) and evaluation (E).

Analyst

Analysis (analysis) is doing assessment needs (analysis of needs), identify problems (needs), and perform analysis tasks (task analysis). Phase analysis is a process to define what will be learned by study participants, namely conduct needs assessment (analysis of needs), identify problems (needs), and perform analysis tasks (task analysis).

Design

Planning of the model development. Based on the analysis of the results of preliminary research and theoretical studies, started from designing interactive multimedia Biology design which includes: (a). Navigation Structure design, (b). Develop UML, (c) Design Guide Application

Develop

At this stage, the form of needs analysis process, i.e. how the application will be made by the required software (software) and hardware (hardware) in making this application. The hardware needed for application program Augmented Reality Organ in the Human Body ranging from the manufacture, storage, until the program is used in the actual conditions in many terms. The first is a computer used for the design, writing programs and testing program. In addition the program requires a mobile device (mobile device) Android which has a minimum of RAM 512Gb and processor 1Gb type ARMv6 or ARMv7 and camera. This device serves as a medium to install and run the program. Here is a list of hardware that is used to manufacture and run the program.

Table 1. Hardware Requirements

Hardware	Explanation
Laptop	<p>minimum specifications</p> <ol style="list-style-type: none"> 1. Processor Intel Dual Core T2390 1.86 Ghz 2. Memory 2 GB RAM 3. VGA On Board 4. Hard Disk 20 GB
<i>Mobile Device</i>	<p>Minimum specifications</p> <ol style="list-style-type: none"> 1. Operating System Android 2.2.1 (Froyo) 2. Processor ARMv6 600MHz 3. Memory 512 MB RAM 4. Screen QVGA (240 X 320) pixel 5. Camera

Besides the hardware, it is also required software for creating the programs and implementing them. In addition to the operating system that became the basic software – another software, design programs for the Android operating system developers needed software – supporting software including the JDK, ADT Plugin, Android SDK, Vuforia Qualcomm, Unity 3D.

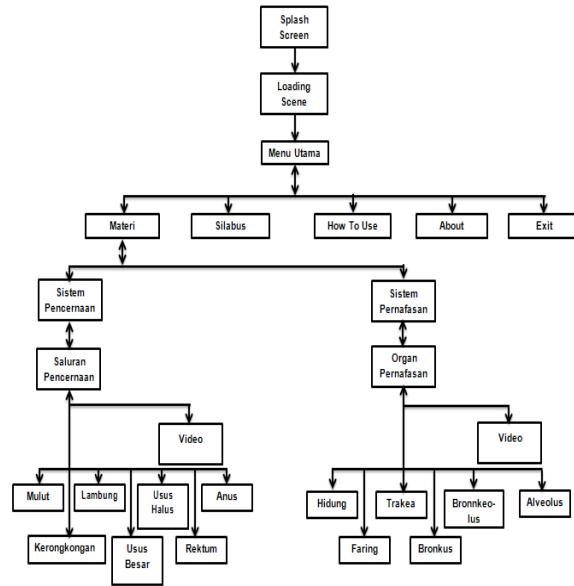
Table 2. Software Needs (*Software*)

Software	
Operating system Windows XP SP3	Operating systems that are used in the manufacture of application
Java Development Kit	Tools developer of the Java programming language.
Vuforia Master Package 2-0-6	<i>Library Augmented Reality</i> that used to make the application
Mono Develop	
Android Development Tools (ADT <i>plug-in</i>)	<i>Plug-in</i> which is used to integrate eclipse into Android development environment.
Android SDK (<i>Software Development Kit</i>)	<i>Tools</i> Android developer program
Unity 3D	The program's interface in the form of 3D objects and video.
Blender	Make and edit 3D objects
Adobe Photoshop CS6 32bit	Making the material on 3D objects and icons on the application.

Designing Application

Structure Navigation Design

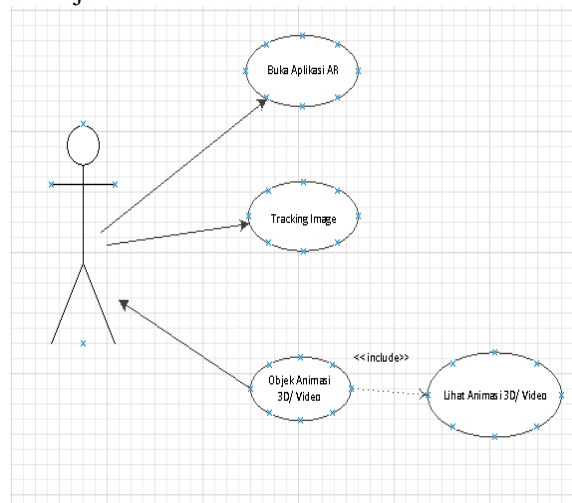
Navigation Structure is used to describe in outline the contents of the application and describe how the connection between the contents. Augmented Reality Navigation Structure of Learning Biology in Human Body Organ mobile based is a mixed navigation structure.



gambar 1. stuktur navigasi

Use Case Diagram

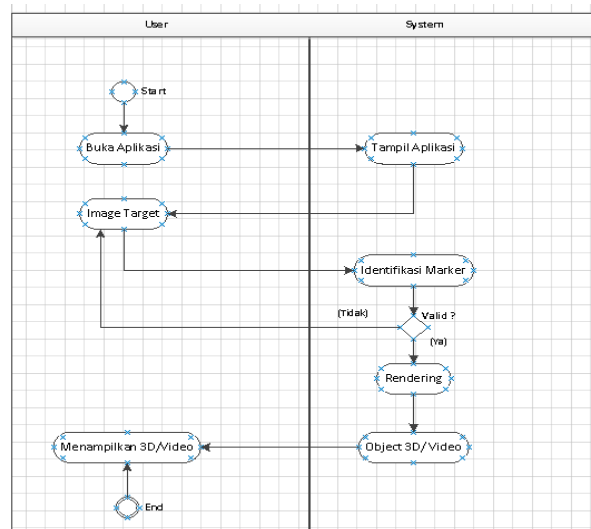
In picture no.2 is the Use Case Diagram of Augmented Reality Human Body Organ Application. In Augmented Reality Application there are three use cases which performed by the user. Firstly, user will open or run the application, then user will do image tracking, then the results of the image tracking the user will get a 3D animated object or Video.



gambar 2. Use Case Diagram

Activity Diagram

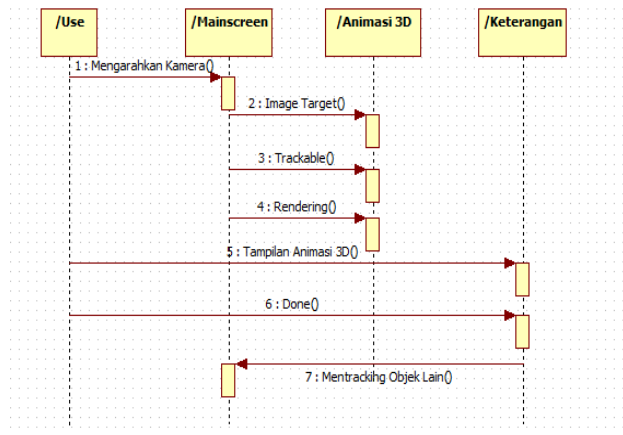
In picture no.3, here is a diagram activity from use case image tracking, there is activity which performed by the user and performed by the system application during the process of image tracking.



Gambar 3. Activity Diagram Tracking Image

Sequence Diagram

In picture no.3.5 is a sequence diagram of use case tracking image, in this sequence diagram is the series of steps – the steps which has taken at the time tracking image process.



Gambar 3. Sequence Diagram Tracking Image

Pages Design

In designing this application, there is an opening page (splash screen), material menu (main), syllabus, method of use, application information, and exit.

Starting from the opening pages that display the application and Gunadarma logo, followed by loading scene waiting for the next process proceed to the main menu. On the main menu there are five buttons which are material, syllabus, method of use, application information, and exit. On the material menu there are three buttons: internal organ, respiratory system and digestive system. The internal organ menu contains submenu overview and video. The digestive system menu contains submenu video of digestive system, mouth, esophagus, stomach, large intestine, small intestine, rectum, anus and complete

organ. While on the respiratory system menu there is a submenu video of nose, pharynx, trachea, bronchi, bronchioles and complete organ.

Opening Menu Design (*Splash Screen*)

The Opening page is the first page to appear when the application runs. On this page will display the application logo.

a. Opening Menu Design

Opening menu is the beginning menu before we enter to the main menu.

b. *Study Menu*

Syllabus Page Menu contains material information about the teaching materials which discussed on Augmented Reality Human Body Organ application. This page will appear if the syllabus button on the opening menu selected.

c. Material Menu Design (Main Menu)

Material Page Menu is the main display of this application. This page will appear if the material button on the opening menu is selected. The design of the material menu.

d. Internal Organ Menu Design

This page will display the augmented reality while camera phone device is directed to the magic marker book. The information that would appear to be a complete human body organ object in 3D form and video files.

e. Digestive System Menu Design

This page will display the augmented reality while camera phone device is directed to the magic marker book. The information that would appear to be a digestion system organ object and human food digestive process video files.

f. Respiratory Menu Design

This page will display the augmented reality while camera phone device is directed to the magic marker book. The information that would appear to be a 3D object and respiratory system organ object and human respiration process video files.

g. How To Use Page Design

How To Use Page menu contains about the information of the way in using Human Internal Organ Augmented Reality Application. This page will appear if How To Use button in Opening Menu is selected.

h. Application Info Design

Application info page will appear when the user selects the 'About Application' button. This page is a page that displays information about Augmented Reality applications of Human Body Organ which has created as the application version, production year, as well as the name of the application maker.

Implementation and Evaluation

At the stage of implementation was conducted by making the overall application, started from the manufacture of objects that included a 3D object design and coloring material 3D objects, video creation, and the creation of applications such as typing program code (C #) in Unity3D.

Trial

The process of application of the first test is to use a software emulator contained in Unity, so that the application is completely operable as its function tested prior to the next stage of the mobile device (mobile device). If there is a mistake (error) then it will be repeated at the implementation stage (the creation of applications), but if there are no errors it will be tested in the next stage of mobile devices. The second trial process is on mobile devices that used the Android platform, with at least version 2.2 (Froyo) and processor ARMv6 and ARMv7 (processor smartphone Android architecture). If an error occurred (error) while the test using a mobile device, it will be restored to the implementation phase.

Results and Discussion

From the results of questionnaires distributed to 20 students of SMAN 34 Jakarta, it can be concluded that the percentage of 76.75% for overall value and can already be said to be good. As for the aspects of the appearance of percentage 77%, aspects of application quality of percentage of 73.6%, aspects of the presentation of the material obtained percentage of 76.2%, aspects of user interaction 78, 25%, 80% aspects of the interaction program, aspects of learning design and visual communication obtained 76.5% and the percentage of the sixth aspect of this application is said to be good. While the application of the test results performed on the mobile device android conclusion that of some smartphones in the test, the Samsung Galaxy SI, Samsung Galaxy Tab, Samsung S4, Galaxy Note10.1 and Lenovo A390, successfully run applications due to their specifications which have already met specification of Unity 3D was ARMV 7. But for the Samsung Galaxy Gio S5660 cannot run applications because they used ARMV 6 and RAM is too little 278MB.

Suggestion

The authors recognized that there are still many opportunities to develop this application to make it more attractive and useful. Thus the need to do further research to include audio or sound, making objects become much more interactive. Object storage that is still in the application making the required memory space is large enough for the android device as a further development can be made with the cloud for data storage.

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