No. 508 | REC. 01-12-2021 | REV. 09-01-2022 | ACC. 22-03-2022

P.ISSN: 2086 – 4981
E.ISSN: 2620 – 6390
tip.ppj.unp.ac.id

Jurnal Teknologi Informasi dan Pendidikan
Volume 14, No. 3, December 2021
PG. 35 – 40 | https://doi.org/10.24036/tip.v14i3

Augmented Reality Technology For 3D Photoelectric Simulation

Afif Rahman Riyanda*[1], Nizwardi Jalinus[2], Sukardi[2], Waskito[2], Fadhli Ranuharja[2], Agariadne Dwinggo Samala[2], Novi Hendri Adi[3]

[1] Department of Information Technology Education, Universitas Lampung
[2]Faculty of Engineering, Universitas Negeri Padang
[3] Faculty of Engineering, Universitas Ibnu Sina
Corresponding Author: afif.rahman@fkip.unila.ac.id

INTISARI

Penelitian telah dilakukan pada pengembangan Simulasi Fotolistrik 3D berdasarkan Augmented Reality. Studi pendahuluan ini untuk menganalisis ketersediaan visulasi fotolistrik bekas dan prakticum di SMA di Lampung dan berapa banyak guru fisika yang belum menggunakan alat bantu mengajar berupa alat fotoelctric atau kandang sumber cahaya merkuri. Berdasarkan penelitian awal, disimpulkan bahwa masih sangat sedikit guru fisika yang menggunakan alat fotoelctric atau kandang sumber cahaya merkuri dalam pembelajaran fisika SMA. Oleh karena itu, sangat perlu untuk mengembangkan POLARISKOP KIT beserta bahan ajar dengan BANTUAN LMS. Tahapan pengembangan KIT dalam studi pendahuluan ini baru mencapai tahap desain fotolistrik Simulasi 3D dan uji validasi desain.

Kata kunci: *3D Photoelectric, Augmented Reality, Media Pembelajaran*

ABSTRACT

The research has been conducted on the development of the 3D Photoelectric Simulation based on Augmented Reality. This Preliminary study is to analyze the availability of used photoelectric visulations and prakticum in High Schools in Lampung and how many physics teachers have not used teaching aids in the form of photoelctric tools or mercury light source enclosure. Based on the preliminary research, it was concluded that there are still very few physics teachers who use the photoelctric tools or mercury light source enclosure in High School physics learning. Therefore, it is very necessary to develop the Polariskop KIT along with teaching materials with LMS Assistance. The stages of developing the KIT in this preliminary study have only reached the 3D Simulation photoelectric design stage and design validation test

Keywords: *3D Photoelectric, Augmented Reality, Learning Media*

INTRODUCTION

Industrial Revolution Era 4.0 which fundamentally resulted in changes in the way of human thinking, even directly will disrupt the human activities in various fields, not only in the field of technology or manufacturing [1][2][3] and will definitely lead to the field of education. The 4.0 Industrial Revolution in the world of education is marked by the start of interconnection or the connection of users to each other to the internet [4] or in short is a learning medium assisted by digitizing technology (applications or software).

The education sector has prepared and even followed changes in the Industrial Revolution 4.0 era. Especially, the development of instructional media ranging from conventional (traditional) to digitalization using certain software [5]. Learning media are grouped into 9 types in the form of audio, printed material (photos), still images, printed images, audiovisual projections, moving images, sound images, objects (objects), and computers [6].

Learning media, especially physics, have evolved along with the development of Information and communications technology (ICT), both instructional media in the form of pictures and videos. Many research developments in the

Indonesian competing on the use of ICT-based learning media. Development in the 21st century, Indonesia is still developing learning media from 2D simulations [10][11]. This has lagged with developing countries where ICT-based learning media have reached 3D simulations. On the positive side, Indonesia has developed a lot of 3D simulation or visualization for now [12-14]. Although, in the field of education there are still a few topics developed. Nobody even developed a topic with an abstract concept, one of which was the photoelectric effect.

Augmented Reality (AR) is the development of virtual reality (VR). However, AR and VR have a very clear difference that is, virtual reality tries to change all real environments into virtual or virtual forms, by adding some real objects for a particular purpose[3][4]. Meanwhile, augmented reality tries to add virtual elements or objects into the real world or be understood by incorporating virtual into a real environment, so that users are sure that their environment is really real which is integrated through certain input devices, and good integration requires an effective assessment [12] that runs interactively in real-time, and there is integration between objects in three dimensions or two dimensions, namely virtual objects integrated in the real world [14]. The product in the form of Augmented Reality can be observed in the following picture.

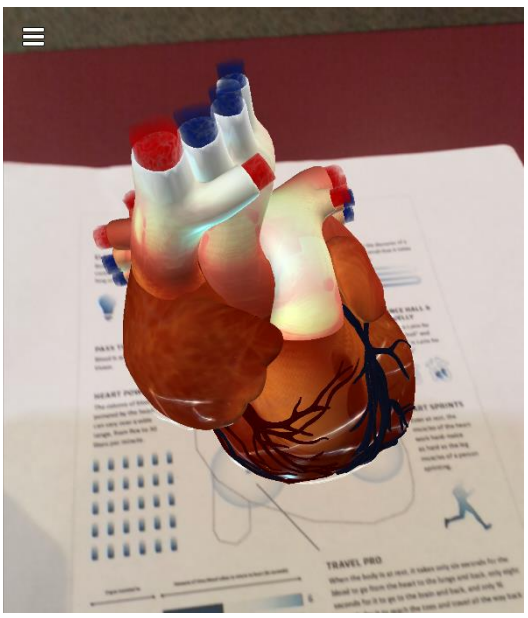

Figure 1. Example of 3D Augmented Reality Visualization in learning [14]

Augmented reality system has three main components, namely (a) Tracking System determines the position and orientation of objects in the real world, (b) Graphic system uses the information provided by the tracking system to describe virtual objects at the appropriate place, and (c) The display system combines the real world with virtual images and sends the results to the user.

This is one solution in the process of learning physics with several abstract concepts. Abstract concepts that make learning physics more difficult. One of the topics of physics in high school that has an abstract concept is the photoelectric effect. The abstract is because at the junior high school level even the high school does not have any teaching aids or practicum used to observe the photoelectric effect phenomenon directly. Thus, learning the topic of the photoelectric effect is only reading theory in a book or even just listening to a story from a teacher. It should be expected that physics learning students not only have the ability to master the concepts of physics (basic thinking skills) but also have the ability to reason in thinking inductive and deductive analysis (critical thinking abilities) and have the ability to develop knowledge and attitudes of confidence (the ability to think creatively).

These abilities are part of the ability to think at a higher level.

This capability was introduced to the US-Based Partnership for 21st Century Skills (P21) which identified the competencies needed in the 21st century, namely "The 4Cs" - communication, collaboration, critical thinking, and creativity. These competencies are important for students in the context of core subject areas and 21st century themes. According to the Deputy Minister of Education and Culture of Indonesia, future challenges such as skills and clear and critical thinking are 2 of the 10 reasons for developing the 2013 curriculum.

Some of these things underlie or motivate researchers to develop 3D Augmented Reality visualization applications that can be opened via Android phones on the subject of physics learning photoelectric effects. With the help of

P.ISSN: 2086 – 4981
E.ISSN: 2620 – 6390

the 3D Augmented Reality visualization application, the phenomenon of the photoelectric effect can be observed directly without props. This makes Augmented Reality 3D visualization a solution.

METHOD

The method used in this research is research and development. This study aims to obtain a 3D visualization software product photoelectric effect material as a supplement or support of valid, practical and effective high school physics learning. In the research and development method, there are several types of models, one of which is the 4-D development model. This development model has advantages when it is used in developing learning equipment products (not learning systems) because the stages of implementation are divided in detail and systematically.

Figure 2. Development Model [15].

Augmented Reality-based products require some software to design and develop. This software is a basic program on a computer.

2.1 Blender

The following open-source software is used to create multimedia content especially 3 dimensions. Blender has a function as 3-dimensional modeling that can create characters and is designed to move, a powerful tool for surface coloring models and lighting studios for a film. Blender has the advantage of other 3-dimensional software, which has its own compositing module, so the results of a love photoshoot can be directly inserted and integrated with a three-dimensional model.

2.2 Vuforia

Vuforia was developed by Qualcomm to support the manufacture of AR. Vuforia uses a source that is a consistent target of computer vision that focuses on image recognition. Vuforia has several types of targets 1) Image Targets, 2) Frame Markers, 3) Multi-targets, 4) Virtual Button. Vuforia SDK requires several important components in order to work properly, namely image converter, tracker, video background rendering, application code, trackable, and maker [16].

2.3 Unity 3D

Unity 3D is an integrated tool for the form of three-dimensional objects in video games or for other interactive contexts such as architectural visualization or real-time 3D animation [17]. Unity 3D has a complete framework for the development of various professional technologies. This engine system uses several programming languages, including C #, javascript and BooScript. Unity has a variety of functions and has a variety of features that can be used, namely Scripting, movie texture, platforms, and asset stores.

The development process is subject to test validation (expert testing and product trials). Expert tests are carried out to determine the feasibility of the products produced based on the suitability of the product in terms of materials and design. Meanwhile, product trials are conducted to obtain information about the product's use from the developed teaching aids. The final stage of this development is integration with the Learning management system, which is a product in the form of Augmented Reality media and module books will be used in online learning.

RESULT AND DISCUSSION

Spesification Product or Preliminary Studies

The preliminary study is in the form of preliminary research in the form of observations from several schools conducted in 2017. Preliminary research results obtained that from a number of junior and secondary schools in rural areas (rural) or middle (Urban) found 93% of students have mobile phones or smartphone with the Android operating system. In fact, the smartphone that is used is connected to the internet or in other words activities of internet use by individuals. This statement is supported by the results of a survey conducted by several survey institutions.

The results of a survey conducted by Balitbangsdm kominfo on 2017 [18], show the results, namely more than half of The Indonesian people already have a smartphone or smartphone with 84.14% of the total sample on the island of Sumatra that has a smartphone. While among students 70.98% had a smartphone.

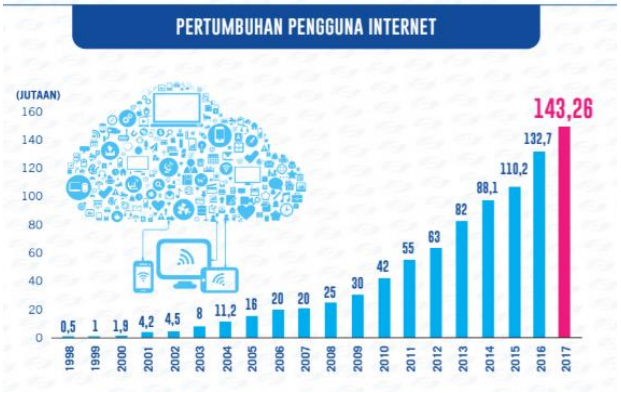

Figure 3. Growth in Internet Usage [15].

The results of the Ministry of balitbangsdm kominfo survey were reaffirmed by the results of the 2017 survey released by APJII (Indonesian Internet Service Providers Association) with multi-stage cluster sampling, internet usage penetration by city/district was concentrated in urban areas with a percentage of 72.41%, rural-urban 49, 49%, and rural 48.25%. The survey results can be said to have increased to 143.26 people from a total population of 262 million people, compared to the previous results of 132.7 million people. This is partly due to the 50.08% smartphone/tablet ownership of the total population in Indonesia [15].

Theoretical background

The photoelectric effect is characterized by the effect of light as electromagnetic waves and energy carriers on the electrical properties. The surface of a metal is illuminated with a beam of light and a number of electrons emitted from the surface [16]. The photoelectric effect experiment is carried out by measuring the rate and kinetic energy of the emitted electron depending on the intensity of the light and the wavelength of the light source. The result is the light intensity only affects the large value of the current passing through the circuit.

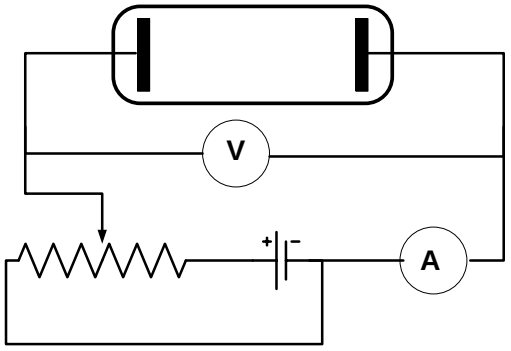

Figure 4. Photoelectric effect experiment scheme [15].

Figure 4 is an experimental photoelectric effect scheme. The light shines on the metal surface (cathode) causing electrons to bounce (excitation). The electron is trying to move towards the anode.

Design and Developing Product

The process of making a product is an integration of the design stage of the interface with various applications in the programming language. Steps that need to be done at this stage (1) Designing 3D objects aided by the application "Blender" (2) asset preparation, namely installing "Unity 3D" as the main software on the computer, (3) making maker, as a virtual object marker will be installed, (4) upload the maker that was made to "Vuforia" for verification (5) to create a new project in Unity 3D.

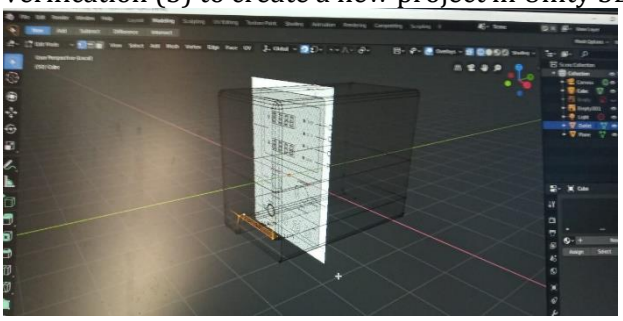

Figure 5. Design 3D objects using "Blender"

Starting from making the main menu by importing designs that have been made into the Unity 3D project. Action is given to each button to work when the button is pressed. Programming continues until all designs can be run on the smartphone.

P.ISSN: 2086 – 4981
E.ISSN: 2620 – 6390

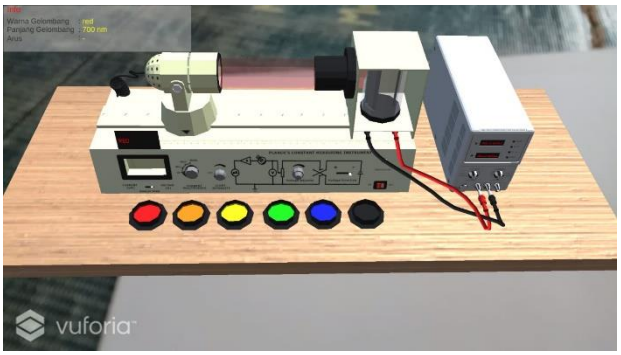

Figure 6. The final product displayed when scanning a barcode

Experimental result validation

The application testing phase is carried out by debugging the application into a smartphone, to determine the level of success when used on several different types of smartphones. In addition, conformity testing with the "photoelectric effect" theory was carried out.

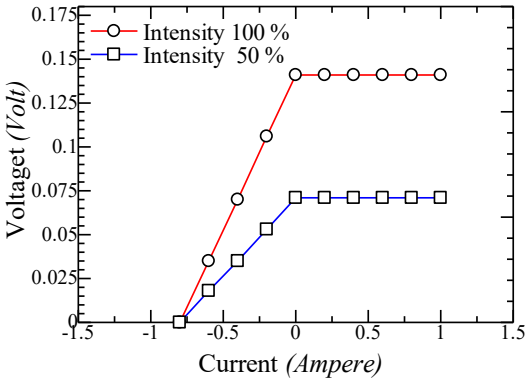

Figure 7. Graphic Relationship of Voltage and Current to Intensity in 3D Photoelectric Simulation Based on AR

Figure 7 shows the measurement results in the form of the relationship between voltage and electric current in a series of photoelectric effects on changes in light intensity. The media is able to show the photoelectric phenomenon, that is when light hits the metal plate and without a voltage source results in current flow. However, when the voltage source is reversed the polarity of the current value gets smaller. When the voltage is -0.08 V in various intensities, there is no current flow (0 A).

CONCLUSION

The resulting product is an Augmented Reality-based 3-Dimensional Photoelectric effect simulation that has passed material development and testing. Furthermore, the product will be continued with expert testing, product testing, and dissemination. From the results of the expert test, it was found that the photoelectric media was very valid and the product trial obtained some additional suggestions so that students could use it more easily. The media trial by SMA 1 Lampung students was tested for effectiveness using a post-test and it is proven that this media can improve student learning outcomes.

The results of this study obtained data in the form of several conditions where the test was carried out using student smartphones with different specifications. For using the application using an android smartphone that has 2 GB of RAM and below, the AR application does not run smoothly, making it difficult for students to learn to explore further. The final result of this development in the form of AR Photoelectric application products in Physics subjects can replace conventional learning and is proven to be more effective as seen from the post test test.

REFERENCE

[1] R. Balebako, J. Jung, W. Lu, L. F. Cranor, and C. Nguyen, "Little brothers watching you:" raising awareness of data leaks on smartphones," *SOUPS 2013 - Proc. 9th Symp. Usable Priv. Secur.*, 2013, doi: 10.1145/2501604.2501616.

[2] M. Kan, "Android Malware Abuses App Permissions to Hijack Phones," 2019. pcmag.com/news/android-malware-abuses-app-permissions-to-hijack-phones (accessed Mar. 25, 2021).

[3] K. Degirmenci, "Mobile users' information privacy concerns and the role of app permission requests," *Int. J. Inf. Manage.*, vol. 50, pp. 261–272, Feb. 2020, doi: 10.1016/j.ijinfomgt.2019.05.010.

[4] S. Rosenthal, O. C. Wasenden, G. A. Gronnevet, and R. Ling, "A tripartite model of trust in Facebook: acceptance of information personalization, privacy concern, and privacy literacy," *Media Psychol.*, vol. 23, no. 6, pp. 1–25, 2019, doi: 10.1080/15213269.2019.1648218.

[5] E. W. T. Darmaningrat, H. M. Astuti, and F. Alfi, "Information Privacy Concerns Among Instagram Users: The Case of Indonesian College Students," *J. Inf. Syst. Eng. Bus. Intell.*, vol. 6, no. 2, p. 159, 2020, doi:

10.20473/jisebi.6.2.159-168.

[6] V. Paramarta, M. Jihad, A. Dharma, I. C. Hapsari, P. I. Sandhyaduhita, and A. N. Hidayanto, "Impact of user awareness, trust, and privacy concerns on sharing personal information on social media: Facebook, twitter, and instagram," *2018 Int. Conf. Adv. Comput. Sci. Inf. Syst. ICACSIS 2018*, pp. 271–276, 2019, doi: 10.1109/ICACSIS.2018.8618220.

[7] C. B. Foltz and L. Foltz, "Mobile users' information privacy concerns instrument and IoT," *Inf. Comput. Secur.*, vol. 28, no. 3, pp. 359–371, 2020, doi: 10.1108/ICS-07-2019-0090.

[8] T. D. Dos Santos and V. F. De Santana, "Computer anxiety and interaction: A systematic review," 2018, doi: 10.1145/3192714.3192825.

[12] E. Princi and N. C. Krämer, "Out of Control – Privacy Calculus and the Effect of Perceived Control and Moral Considerations on the Usage of IoT Healthcare Devices," *Front. Psychol.*, vol. 11, no. November, 2020, doi: 10.3389/fpsyg.2020.582054.

[9] E. O. Kurniawati, A. Kusyanti, and R. I. Rokhmawati, "Analisis Faktor-Faktor yang Memengaruhi Pemahaman Privasi Informasi pada Pengguna Smartphone di XYZ dengan menggunakan Mobile User ' s Information Privacy Concerns (MUIPC)," *J. Pengemb. Teknol. Inf. dan Ilmu Komput.*, vol. 2, no. 4, pp. 1358–1365, 2018.

[10] V. M. Wottrich, E. A. van Reijmersdal, and E. G. Smit, "The privacy trade-off for mobile app downloads: The roles of app value, intrusiveness, and privacy concerns," *Decis. Support Syst.*, vol. 106, pp. 44–52, 2018, doi: 10.1016/j.dss.2017.12.003.

[11] F. Ranuharja, B. R. Fajri, and A. D. Samala, "SISTEM PELAYANAN BANTUAN MENTOR BIMBINGAN BELAJAR (BAMBIMBEL) BERBASIS WEB," *J. Teknol. Inf. dan Pendidik.*, 2020.

[12] G. Ganefri, B. R. Fajri, F. Ranuharja, F. Prasetya, R. Fadillah, and F. Firdaus, "MINI SERVER LENTERA SEBAGAI ALTERNATIF PEMBELAJARAN DIGITAL DI DAERAH 3T," *J. Teknol. Inf. dan Pendidik.*, 2019.

P.ISSN: 2086 – 4981
E.ISSN: 2620 – 6390