International Journal of Engineering Trends and Technology
ISSN: 2231 – 5381 /doi:10.14445/22315381/IJETT-V69I8P226

Volume 69 Issue 8, 211-217, August, 2021

Internet of Things for Detection Disaster Combined with Tracking AR Navigation

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Abstract *- Disaster detection is considered very important, especially using current technology, namely the Internet of Things (IoT). Many IoT tools have been integrated with cyber applications or vice versa with the use of gamification. In the research that will focus on the waterfall method, the questionnaire and the authors focus on the integration of IoT in augmented reality (AR) to find areas of discovery. AR navigation is considered an important technology to help in various aspects. The important thing is that AR navigation is made in this research using game engine application software with IoT technology on ESP32 on the microcontroller. Research results, applications in AR, and early detection of IoT using User Experience (UX). This tool produces good attribute responses according to the questionnaire. But there need to be improvements in terms of attractiveness attributes.*

Keywords — *Augmented Reality, Internet of Things, User Experience (UX)*

I. INTRODUCTION

Traditional disaster detection systems work on systems that are still inefficient and expensive [1], [2]. The era of technology is developing rapidly, along with the need for problems that arise. These various problems that arise can be overcome by technology, both in education, agriculture, medicine, and others cannot be separated from the role of technology. The technology most needed today is the internet [3], [4]. All forms of work will be overcome with internet technology which cannot be separated from the supporting devices. Internet of Things (IoT) is a technology that uses the internet to do things. The IoT system is very helpful in solving problems such as in the field of education in networks[3], [5], [6].

IoT is any behavior in which everyone interacts with each other using the internet. The Internet of Things is seen in various aspects, such as online transportation, e-commerce, online ticket booking, live streaming, e-learning, others, and even plantation tools. Offices to large industries in specific fields using sensors, GPS tracking, and a network-connected as a medium for data transfer. With the many benefits of the Internet of Things [7]–[10], everything is more accessible. In education, IoT is essential to carry out all activities using the system and then organizing and correcting the filing system.

In this study, augmented reality as a combination of IoT and AR tracking on real and virtual objects during disasters runs very actively to the user directly. There is a collaboration between three-dimensional objects, namely virtual objects that are embedded with real objects. The fusion of IoT and AR navigation is possible with appropriate display technologies, interactivity is possible through specific input devices, and good integration requires effective tracking.

In previous studies [11], the integration of IoT and Augmented reality was used for agricultural purposes. Where the detection uses IoT, and the results are displayed in AR. IoT-AR technology produces excellent images in its utilization. According to [12]. Almost the same as in the beginning, its use is still in good pictures, and depictions can be different as desired. A few things about seldom investigating early fire discovery in the past include getting away elude reason courses. Subsequently, analysts attempt to do a few tests at the approximately early location using Augmented Reality (AR) [13]. But there are no studies that directly discuss the use of AR tracking during the early disaster and got results from using questioner

Toolmaking is expected to be the latest research between IoT and AR integration. But the result of the application needs to be seen from its accuracy function. This study used a questionnaire that utilizes attractiveness, perspicuity, dependability, novelty, etc. Using the User experience questionnaire (UEQ)[14] tool is also expected to produce good usage attribute results.

II. LITERATURE REVIEW

Previous research [12] and [13], its utility is still within the setting of great pictures, and portrayals can be utilized as wanted. Therefore, more details will be described in the following table:

Table 1. Previous Research

No	Author	Title	Result
1	Di Wang, Xiausu Xu, Yiqing Yao, Yongyun Zhu, and Jinwu Tong[15]	*A Hybrid Approach Based on Improved AR Model and MAA*	The proposed approach is assessed by recreation and exploratory test in numerous

		for INS/DVL Integrated Navigation Systems	increasing speed bound and the DVL blackout for an AUV. The comes about demonstrate that the precisions of the speed and position are made strides successfully, particularly in complex movement demeanor and long cruising conditions
2	Pilaiwan Phupattanasilp and Sheau-Ru Tong [11]	*Augmented Reality in the Integrative Internet of Things (AR-IoT): Application for Precision Farming*	In IoT-AR Applications, save IoT information to real-time objects, then raise active queries. As a case example, this research is applied for checking. Using Multi-cameras for precise and effective IoT imaging.
3	Monica Aiswarya Ankireddy, Rajath AV, Ruthwik Ganesh M, Anuradha M [12]	*Early Detection of Forest Fire Based on Unmaned Aerial Vehicle Platform*	AR application for portable gadgets has been implemented, where the client can connect with the augmentation. In this way, the changes made in the AR environment are reflected within the physical world. Within the moment stage, low-cost, portable keen glass has been outlined with highlights to control a gadget by fair having its
			setting
4	Sandhya Baskaran, Hari Kumar Nagabushanam [16]	*Relational localization-based Augmented reality Interface for IOT applications for IoT applications*	create workings and functions for Enhanced Reality collaboration as a non-exclusive form of representation for IoT gadgets that use social localization strategies and metadata data from sensors. This eliminates the need for pre-training AR devices as well as creating the ability to envision information from which IoT devices are participating in the setup.

IoT - AR tools made by researchers have a function as AR navigation gamification to improve the performance of disaster early detection tools using technology. The tool uses a simple ESP32 and game engine applications as a control center and game creation. IoT devices have so many sensors in there, alarm, vibration, standby light, MQ2-Sensor, IR Flame Sensor module. A few systems or ways of working are made to realize all the specified sees, as appeared in Figure 1 [17].

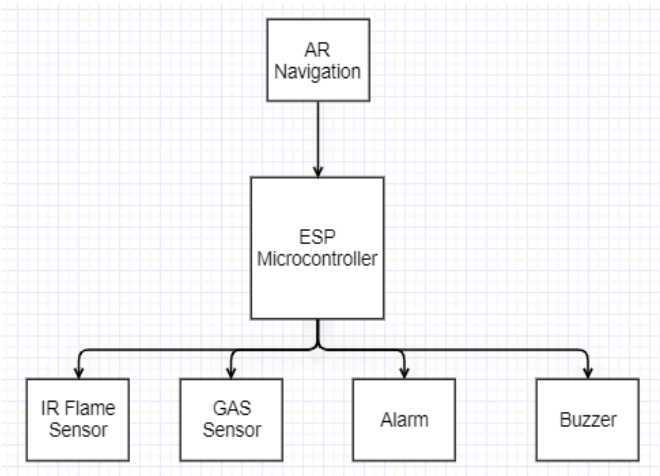

Fig 1. IoT – AR Navigation

Figure 1 shows the system provides how the tool works after getting from the device to apply the results of the AR navigation approach, where this search path will provide a calm effect to the user. It is expected to raise awareness also for users with the help of AR navigation.

This research utilizes the ESP32[18]–[20] microcontroller, a microcontroller member used as a microcontroller in general. ESP32 is a continuation of the previous microcontroller named ESP8266. This similar tool can then be applied to the Arduino IDE software. There is a signal sender and receiver module in this microcontroller. There is the addition of Bluetooth Low Energy in the device, so according to the researcher, it is very suitable for use in this study. Researcher selection to create an IoT-AR application system.

For AR navigation in this research[21]–[23], game engine software is used, Game Engine Software. which are very active and interactive in their use.

III. METHODOLOGY

A. Waterfall Model

Researchers in this study used the waterfall application method to build this tool. These are the methods commonly used to create devices and apps[24], [25]:

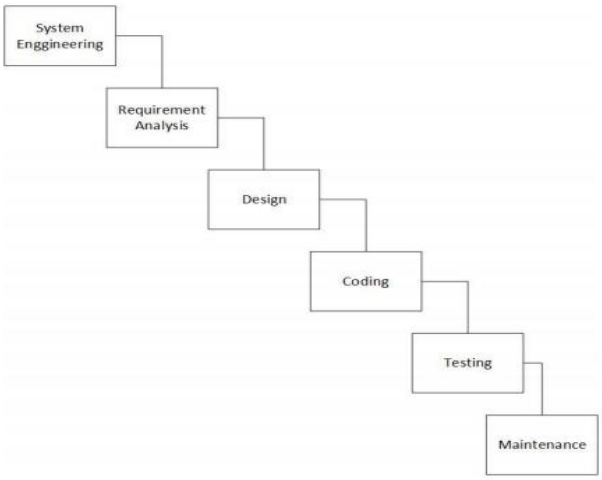

Fig 2. Waterfall Model

B. AR Navigation Creation

AR-based applications [26] use the mobile phone as the parent for navigation after the IoT has succeeded in reading disaster early detection. The evacuation route becomes a representation of the route path that will be marked with an arrow. This application is made using Game Engine Software 3D for the android platform[27]. Figure 3 will show the approach to create this android application. Furthermore, to fulfill object-based programming, several program commands are performed to integrate objects.

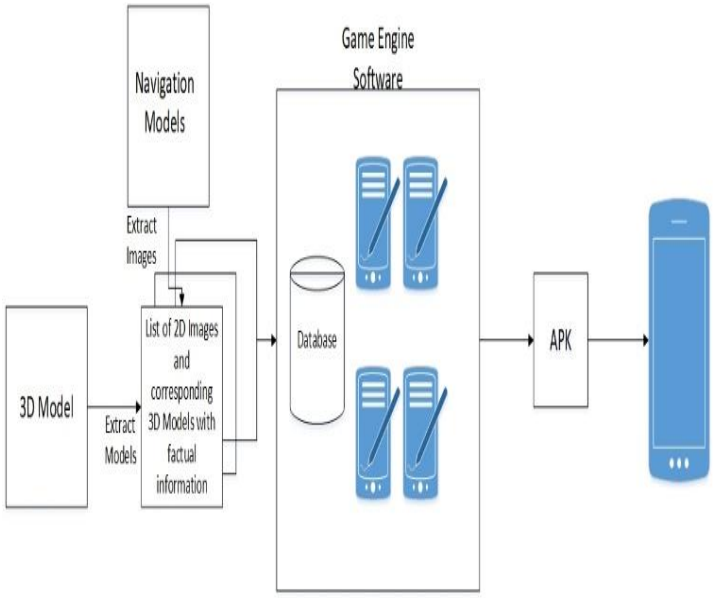

Fig 3. AR Application Approach

C. User Experience Quissioneir

This questionnaire is one of the tools used to measure the user experience of a product. This study is intended for AR navigation applications. The purpose of using this questionnaire is to assess the perceived user experience of a product quickly. There are 6 measurement scales in UEQ [28], namely:

1. Attractiveness: Do users like the product?
2. Perspicuity: easy to become familiar with when used?
3. Efficiency: Is AR navigation very effective to use
4. Dependability: Can the user predict the behavior of the system?
5. Stimulation: Is the product motivating and interesting when used by the user?
6. Novelty: Does the product have a display innovative and creative so that they can attract users

D. Stages of Making a Questionnaire

After knowing the method of making tools and making AR navigation, this section will explain how to find a questionnaire with a total of 70 respondents using UEQ. The following is a methodology chart [29]:

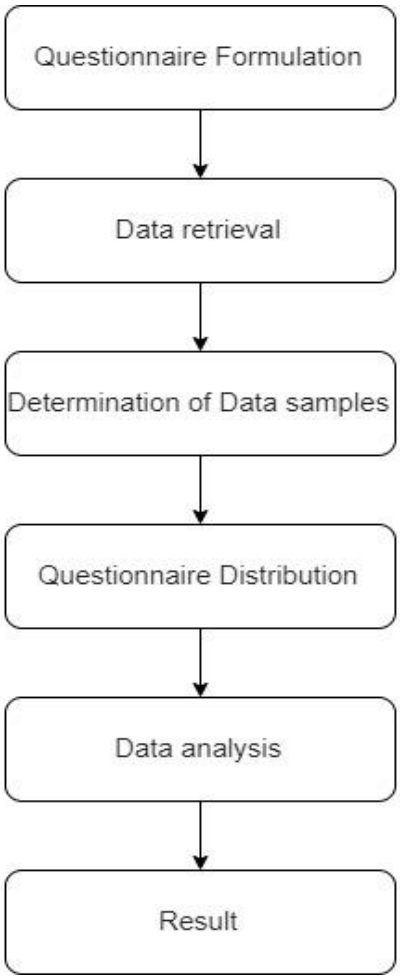

Fig 4. Questionnaire Method

Using Figure 4, the researcher will start using the UEQ optimally and on target according to the image. Expected to get attribute results following participant expectations

IV. EXPERIMENTAL RESULT

A. Waterfall Result

By using the waterfall method, researchers get the results of methods such as:

- System Engineering

The system tool used in this study uses the usual Arduino IDE and for AR navigation using Game Engine Software.

- Requirement Analysis

The needs of users that are examined are offices and large malls, where the needs are disaster early detection alarms and navigation routes to prevent panic

- Design

The researcher focused on creating the display in AR. The show is made as simple as possible. This is because when using the navigation application, the user will undoubtedly feel panicked.

- Coding

After determining the needs and designs that have been made, the application goes directly to coding, using the Arduino IDE and Game Engine Software. use C in the IDE and C#

- Testing

At this stage, it is done in housing. Because the government still applies the work system. The result is good getting feedback from users through a questionnaire

- Maintenance

The maintenance phase is used by developing tools, as well as AR navigation applications

The following are the results of a disaster early detection tool using AR navigation. The material used is mild steel, with sensors that can detect disasters, especially fire disasters:

Fig 5. Early Disaster Detection Tool

B. AR Navigation Result

This application is intended and has been built as an AR-based navigation pointer to display evacuation route information. This AR route form is formed in a real 3D world and displayed on a marker or evacuation route to find a way.

The construction of this application is very important. So that it can minimize panic when looking for evacuation routes to find a way out in offices and malls and reduce anxiety for users and customers. In addition, this application uses a special identification library as a tool to create Augmented Reality applications. Here are the results of the AR Navigation

Fig 6. AR Navigation Results 1

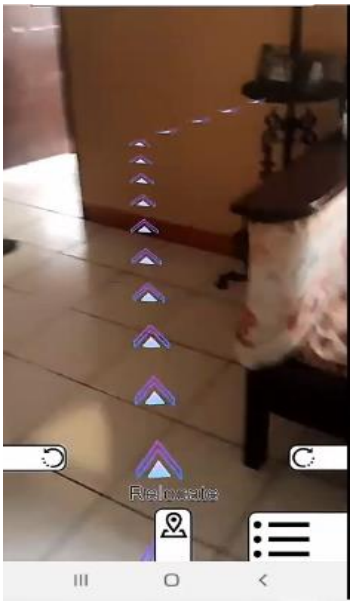

Fig 7. AR Navigation Results 2

C. User Experience Quissioneir

In UEQ, there are 6 attributes. The following is a table of the results of each attribute. The results of this questionnaire were followed by 70 respondents online:

Table 2. Attractiveness Result

No	Mean	Item	Result
1	1.2	Annoying/Enjoyable	Enjoyable
2	1.1	Good/Bad	Good
3	0.7	Unlikeable/Pleasing	Unlikeable
4	1.1	Unpleasant/Pleasant	Pleasant
5	0.2	Attractive/Unattractive	Unattractive
6	0.1	Friendly/Unfriendly	Unfriendly

The average results of applications that are tested well according to UEQ are above 0.8. This attribute in Table 2 does produce poor scores, as in the AR navigation application, which is rated as "Disliked". This happens because everyone may want to use the AR navigation app directly without having to download it. So the author must update the application so that it is easy to download and use by users. The next thing that is lacking is “Unattractive and Unfriendly”. This is because the application has not been integrated with other applications such as the national natural disaster agency etc., So the researcher must add the required integrations so that the attribute results are better.

Table 3. Perspicuity Result

No	Mean	Item	Result
1	1.8	Not Understandable/ Understandable	Understandable
2	1.7	Easy to Learn/Difficult to learn	Easy to Learn
3	1.8	Complicated/Easy	Easy
4	1.8	Clear/Confusing	Clear

Table 4. Efficiency Result

No	Mean	Item	Result
1	0.3	Fast/Slow	Slow
2	2.1	Inefficient/Efficient	Efficient
3	2.1	Impractical/Practical	Practical
4	1.7	Organized/Cluttered	Organized

Table 3-4 shows the results of Perspicuity and Efficiency. In contrast to the previous table, this attribute produces better questionnaire results. One thing may be less than the 0.8 average, which is 0.3 “Slow”. This is because the smartphone used must be the latest Operating System (OS) update. The old version will experience slowness, but it is very good for the new version, and the application is still limited to a certain OS, not covering all existing OS. So researchers need to do more research to make another version of the OS. In addition to other attributes get very good results. So it can be taken if the accuracy and efficiency have a good average result.

Table 5. Dependability Result

No	Mean	Item	Result
1	1.1	Unpredictable/Predictable	Predictable
2	1.5	Obstructive/Supportive	Supportive
3	2.0	Secure/Not Secure	Secure

Table 6. Stimulation Result

No	Mean	Item	Result
1	1.9	Valuable/Inferior	Valuable
2	0.2	Boring/Exciting	Boring
3	1.5	Not Interesting/Interesting	Interesting
4	1.5	Motivating/Demotivating	Motivating
5	0.2	Attractive/Unattractive	Unattractive

Table 7. Novelty Result

No	Mean	Item	Result
1	1.5	Creative/Dull	Creative
2	1.8	Inventive/Conventional	Inventive
3	1.4	Usual/Leading Edge	Leading Edge
4	1.5	Conservative/Innovative	Innovative

Table 5-7 shows the results of dependence, stimulation, and novelty. Almost similar to tables 2 and 3 have positive results because many averages are above 0.8. There is a section below 0.8 is the "Unattractive" section. This happens because AR navigation only displays the search path, not showing anything else. This is an addition for researchers to do a better display. But other than that, the results show a very good average and need to be maintained.

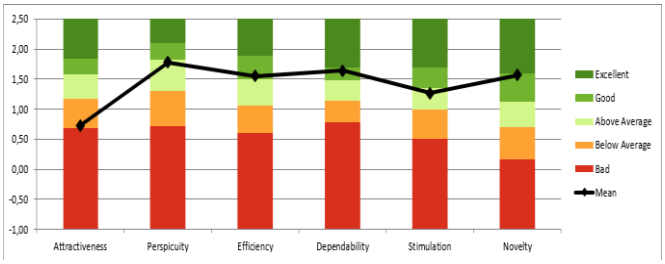

Fig 8. UEQ Total Results Benchmark

Figure 8 shows that the attractiveness attribute shows results below 0.8 and has a value below the average. This happens because AR navigation has not been able to meet user needs. So there needs to be an improvement in this attribute by increasing all attractiveness activities that will improve the questionnaire results. Researchers will make many innovations in the field of attraction. Perspicuity and Stimulation attributes have above average results. This is good and needs to be improved. For Characteristics, Dependability and recency are in a very good area. In order to meet the user's wishes, researchers must maintain some of these attributes and even increase them again.

V. CONCLUSION

The experimental results show that an early detection tool for natural disasters has been successfully created and can be used properly by utilizing the waterfall method, which is very suitable for navigation tools and AR applications. Results from AR navigation applications can be used in conjunction with disaster early detection tools. The results of the questionnaire received a negative response in the attractiveness section. So it takes more hard work to improve the performance of this attribute so that users can be happier in using the application. The results of other questionnaires are good and need to be improved in terms of sharpness and stimulation to get good results. For other parts, it needs to be maintained because it is good. Even innovation needs to be added to increase user feedback.

ACKNOWLEDGEMENT

This work is supported by Research and Technology Transfer Office, Bina Nusantara University, as a part of Penelitian Terapan Binus entitled << Pathfinding Augmented Reality for Fire Early Warning IoT Escape Purpose >> with contract number: No.018/VR.RTT/III/2021 and contract date: 22 Maret 2021.

REFERENCES

[1] E. A. Kadir, S. L. Rosa, and A. Yulianti., Application of WSNs for Detection Land and Forest Fire in Riau Province Indonesia., Proc. 2018 Int. Conf. Electr. Eng. Comput. Sci. ICECOS 2018, 17(2019) 25–28.

[2] M. H. Widianto, I. D. Sudirman, and M. H. Awaluddin., Application of density-based clustering of disaster location in real-time social media., TEM J., 9(3) (2020) 929–936.

[3] Y. A. Alsultanny and M. F. Alotaibi., Evaluating the Factors Affecting on Intension to Use of E-Recruitment., Am. J. Inf. Sci. Comput. Eng., 1(5) (2015) 324–331.

[4] R. Valarezo and T. Guarda., Comparativo de los Frameworks Laravel y Codeigniter Frameworks., 2018 13th Iber. Conf. Inf. Syst. Technol., (2018) 1–6.

[5] İ. Kahramanoğlu, E. D. Ülker, and S. Ülker., Integrating support vector machine (SVM) technique and contact imaging for fast estimation of the leaf chlorophyll contents of strawberry plants., SSRG Int. J. Eng. Trends Technol., 69(3) (2021) 23–28.

[6] H. Chen, C. Yin, R. Li, W. Rong, Z. Xiong, and B. David., Enhanced learning resource recommendation based on online learning style model," Tsinghua Sci. Technol., 25(3) (2020) 348–356.

[7] S. Sharma, A. Sharma, T. Goel, R. Deoli, and S. Mohan., Smart Home Gardening Management System: A Cloud-Based Internet-of-Things (IoT) Application in VANET, 2020 11th Int. Conf. Comput. Commun. Netw. Technol. ICCCNT 2020, (2020).

[8] M. H. Widianto, Ranny, N. F. Thejowahyono, and S. B. Handoyo., Smart mirror technology on the internet of things to enhance interactive learning., Int. J. Emerg. Trends Eng. Res., 8(8) (2020) 4318–4324.

[9] C. Lee and A. Fumagalli., Internet of Things Security-Multilayered Method for End to End Data Communications over Cellular Networks, IEEE 5th World Forum Internet Things, WF-IoT 2019 - Conf. Proc., (2019) 24–28.

[10] S. Ziegler, S. Nikoletsea, S. Krco, J. Rolim, and J. Fernandes., Internet of Things and crowd sourcing - A paradigm change for the research on the Internet of Things., IEEE World Forum Internet Things, WF-IoT 2015 - Proc., (2015) 395–399.

[11] P. Phupattanasilp and S. R. Tong., Augmented reality in the integrative internet of things (AR-IoT): Application for precision

farming., Sustain.,11(9) (2019).
[12] M. A. Ankireddy, A. V. Rajath, M. Ruthwik Ganesh, and M. Anuradha., Augmented reality rendered for IoT applications, 2019 IEEE 16th India Counc. Int. Conf. INDICON 2019 - Symp. Proc., (2019) 0–3.
[13] O. Scheibert., Overcoming the problem of uncertain tracking errors in an AR navigation application, (2020) 11112394.
[14] M. Schrepp., User Experience Questionnaire Handbook Version 8., URL https//www. Res. net/publication/303880829_User_Experience_Questionnaire_Handbook_Version_2.(Accessed 02.02. 2017), (2015) (2019) 1–15.
[15] D. Wang, X. Xu, Y. Yao, Y. Zhu, and J. Tong., A Hybrid Approach Based on Improved AR Model and MAA for INS/DVL Integrated Navigation Systems., IEEE Access, 7(2019) 82794–82808.
[16] S. Baskaran and H. K. Nagabushanam., Relational localization-based Augmented reality Interface for IOT applications., 9th Int. Conf. Inf. Commun. Technol. Converg. ICT Converg. Powered by Smart Intell. ICTC (2018) 103–106.
[17] M. H. Widianto, T. E. Suherman, and J. Chiedi., Pathfinding Augmented Reality for Fire Early Warning IoT Escape Purpose, 69(7) (2021) 190–197.
[18] R. Aisuwarya and E. F. Suhendra., Development of Automatic Fish Feeding System based on Gasping Behavior, 2018 Int. Conf. Inf. Technol. Syst. Innov. ICITSI 2018 - Proc., (2019) 470–473.
[19] G. Hristov, J. Raychev, D. Kinaneva, and P. Zahariev., Emerging Methods for Early Detection of Forest Fires Using Unmanned Aerial Vehicles and Lorawan Sensor Networks, 2018 28th EAEEIE Annu. Conf. EAEEIE (2018) 1–9.
[20] A. Johri, S. Jafri, R. N. Wahi, and D. Pandey., Smart mirror: A time-saving and affordable assistant., 2018 4th Int. Conf. Comput. Commun. Autom. ICCCA (2018) 1–4.
[21] Z. Rongting, S. Yiran, H. Tongliang, and F. Asmi., Applying Augmented Reality Technology to E-Learning: Science Educational AR Products as an Example., Proc. - 13th IEEE Int. Conf. E-bus. Eng. ICEBE 2016 - Incl. 12th work. Serv. Appl. Integr. Collab. SOAIC (2016) (2017) 129–133.
[22] G. Zhao, Q. Zhang, J. Chu, Y. Li, S. Liu, and L. Lin., Augmented Reality Application for Plant Learning., Proc. IEEE Int. Conf. Softw. Eng. Serv. Sci. ICSESS., (2018) (2019) 1108–1111.
[23] A. S. Manasa Venigalla and S. Chimalakonda., Towards enhancing the user experience through a web-based augmented reality museum, Proc. - IEEE 19th Int. Conf. Adv. Learn. Technol. ICALT (2019) 357–358.
[24] M. H. Widianto., Analysis of Pharmaceutical Company Websites using Innovation Diffusion Theory and Technology Acceptance Model., Adv. Sci. Technol. Eng. Syst. J.,6(1) (2021) 464–471.
[25] N. Mukai, Y. Sakai, and Y. Chang., Waterfall simulation by using a particle and grid-based hybrid approach., Proc. - 2014 Int. Conf. Cyberworlds, CW., (2014) 23–30.
[26] F. H. Salman and D. R. Riley., Augmented reality crossover gamified design for sustainable engineering education., FTC 2016 - Proc. Futur. Technol. Conf., (2017) 1353–1356.
[27] C. A. L. Waechter, D. Pustka, and G. J. Klinker., Vision-based people tracking for ubiquitous augmented reality applications., Sci. Technol. Proc. - IEEE 2009 Int. Symp. Mix. Augment. Reality, ISMAR (2009) 221–222.
[28] F. Chen, Y. C. Lin, J. W. Chien, and C. E. Tsai., Virtual reality for digital user experience and interactive learning based on user satisfaction: A pilot study., Proc. - 2016 Int. Conf. Comput. Sci. Comput. Intell. CSCI 2016,1(2017) 374–377.
[29] S. In and F. Asi, Financial accounting)., (2018).