A Playable 3D Virtual Tour for an Interactive Campus Visit Experience: Showcasing School Facilities to Attract Potential Enrollees

2023 9th International Conference on Virtual Reality (ICVR) | 979-8-3503-4581-0/23/$31.00 ©2023 IEEE | DOI: 10.1109/ICVR57957.2023.10169768

Manuel B. Garcia
Educational Innovation and Technology Hub, FEU Institute of Technology
Manila Philippines
mbgarcia@feutech.edu.ph

Danna May C. Mansul
Educational Innovation and Technology Hub, FEU Institute of Technology
Manila Philippines
dcmansul@feutech.edu.ph

Eymard B. Pempina
Educational Innovation and Technology Hub, FEU Institute of Technology
Manila Philippines
ebpempina@feutech.edu.ph

Maria Rona L. Perez
Educational Innovation and Technology Hub, FEU Institute of Technology
Manila Philippines
mlperez@feutech.edu.ph

Rossana T. Adao
Educational Innovation and Technology Hub, FEU Institute of Technology
Manila Philippines
rtadao@feutech.edu.ph

***Abstract*—Advances in technology have revolutionized student recruitment strategies employed by educational institutions. These innovations led to the adoption of virtual campus tours to provide prospective students with an immersive expedition into the school facilities replicated in a digital environment. However, the existing virtual tour technologies pose challenges, including cybersickness in virtual reality and limited interactivity in 360-degree videos. In this study, we fill these research gaps by developing a playable and interactive campus virtual tour where potential enrollees can visit and tour the campuses remotely. In addition to a series of beta tests with enrolled students, we recruited students specializing in game development and their associates to evaluate the application using an extended Technology Acceptance Model (TAM) framework. In this evaluation, we found that the application was well-received by prospective students and was regarded as useful in delivering an immersive campus visit experience. From the TAM perspective, it was evident that there was a significant difference in how enrolled and potential students assess the application in terms of perceived usefulness and behavioral intention. The positive acceptance of the application led to the recommendation of playable campus virtual tours as a tool for improving student recruitment strategies.**

Keywords—virtual tour, campus visit, interactive tour, student enrollment, education services, higher education

I. Introduction

Educational institutions are in relentless pursuit of effective recruitment strategies for potential students [1, 2]. Increasing the enrollment of students is a vital aspect of school administration and beneficial for a variety of reasons. For example, maintaining sufficient enrolled students is necessary for the financial stability of the institution, as it enables the allocation of resources toward staffing, academic facilities, and degree offerings. Furthermore, the availability of additional funds can be invested in mentorship programs, financial aid assistance, and educational technologies [e.g., 3, 4, 5]. Paradoxically, these academic resources and other academic support are critical in improving enrollment as well as retention and graduation rates in higher education [6]. The ever-increasing competition among institutions consequently led to a more market-like environment that influences how universities and schools profile themselves and compete for students [7]. In this regard, there is a growing movement of education becoming increasingly influenced by market forces, such as competition, consumer choice, and the commodification of academic services.

The marketization of education compelled institutions to be creative and innovative in attracting prospective students. Some of the recruitment strategies they use can be broadly categorized into academic programs and offerings, scholarships, marketing and advertising, scholarships, and campus visits. First, offering a diverse range of high-quality academic programs can be useful in catering to the diverse needs and interests of potential students. By offering a variety of degrees and programs, students are also afforded a comprehensive and engaging educational experience, which is a significant factor in student satisfaction and retention [8]. In the realm of marketing, institutions use various channels, such as direct mail campaigns, digital advertising, social media, and print advertisements to reach potential students [9, 10]. The proliferation of digital marketing strategies [e.g., 11] has also led to the growth of progressively sophisticated student recruitment strategies that are cost-effective and highly targeted. Institutions may also offer scholarships and financial aid packages to assist with the cost of tuition and further incentivize students to enroll [12]. This strategy positions a school as an institution that values and supports student success. Meanwhile, other institutions use scholarship and financial support offerings as an opportunity to develop collaborations and partnerships with local organizations and businesses and form mutually beneficial relationships [13]. Finally, a campus visit is another recruitment strategy that offers students a unique opportunity to experience the institution and its facilities. Several studies have exhibited the substantial role of campus tours in shaping potential students' perceptions and attitudes toward the educational institution [e.g., 14, 15].

Advances in technology have revolutionized these strategies for educational institutions, including the way that campus tours are conducted. The widespread availability of technology such as 360-degree videos [16], virtual reality [17], augmented reality [18], and interactive 3D models [19] has introduced innovative approaches to deliver an immersive and engaging experience of the campus visit. These tours enable prospective students as well as visitors (e.g., parents, alumni, community members, and other interested individuals) to explore the campus from the comfort of their own homes. Beyond the first-hand experience of visiting remote locations within a digital environment, virtual touring is also an effective medium for promoting school facilities [20]. In the literature, several studies used virtual reality to create highly engaging experiences of virtual campus tours [e.g., 21]. While it can offer a highly immersive experience, it requires specialized headsets that can limit accessibility for some users. Additionally, not all institutions have the resources to invest in VR technology, making it an inaccessible option for some. As an alternative, this study reports the development of a playable virtual campus tour application where users can control movement and exploration of the campus using a desktop computer or a smartphone.

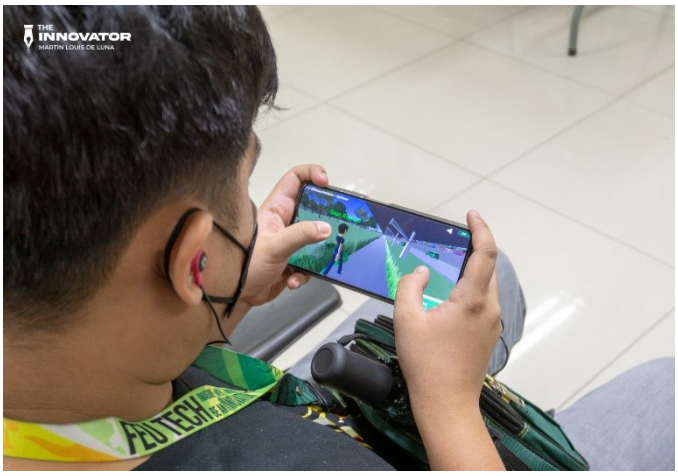

Fig. 1. A Playable Campus Virtual Tour Using a Smartphone.

II. Related Works

Virtual campus tours have obtained increasing attention in recent years as a tool for promoting educational institutions and attracting potential students. Many studies have been conducted to develop and examine the effectiveness of virtual campus tours. For example, one study developed a remote open campus system that enables users to remotely control robots located on school campuses [22]. The developers used the Robot Service Network Protocol to create a communication channel between the service platform and the real world. Another study also employed robots to develop their own remote open campus system [23]. For this version, the robot not only traverses the campus and displays the live camera information but also acts as an agent when users need to converse with another person. Both studies are examples of campus virtual tours that rely on robot technologies, as other technologies (e.g., virtual reality, 360 videos, game technology, and augmented reality) that are more immersive have yet to fully materialize. Nevertheless, robots have been used in other areas, such as art galleries, museums, and cultural institutions, to assist site visitors and interact with humans naturally [24].

Rather than relying on robotics to navigate the campus, other developers utilized 360-degree panoramic images. For example, one study captured spherical panorama photos using ultra-wide-angle lenses to create a visual field with a horizontal and vertical angle of view close to 360 degrees [25]. The pictures taken using a dual fisheye camera were stitched to produce a spherical image format using the determined stitching position. A similar study used the same technology but claimed to integrate auto-stitching using insta360 [26]. Nevertheless, a detailed account of how this auto-stitching works was not included in the discussion. Another study developed a virtual tour application that utilized the photo-stitching technique to generate a panoramic view of the campus [21]. The main goal of this application was to enhance the visitor experience by mimicking the real world via computer-generated environments. Although there was no evaluation conducted with visitors, the study concluded that their virtual tour resulted in the enhancement of visitor experience through a convenient tour of the campus. A virtual tour panorama was also utilized in another study claiming that it allows for better interaction and navigation with a more attractive appearance than regular photos [27].

Another emerging technology in the development of virtual campus tours is augmented reality. Compared to 360 videos and panoramic images, this technology can provide a more vivid and interactive experience by overlaying virtual elements (e.g., text, images, and videos) in the physical environment [18]. One more advantage of augmented reality is that it is accessible through handheld devices without the need for expensive hardware. This technology is thereby a more cost-effective option for schools to showcase their facilities and attract enrollees. One study created an Android mobile application for a campus virtual tour using markerless augmented reality technology [28]. According to the evaluation using the Technology Acceptance Model (TAM), the augmented reality-based campus tour application passed several constructs, such as perceived ease of use, perceived usefulness, user satisfaction, and attribute of usability. In a review of mobile augmented reality for campus tours, it was found that there are features that need to present to improve user experience, such as indoor view, search and navigation, 3D objects, and even games [29]. One study also reported the suggestion of users to integrate social media (e.g., Facebook) to improve the application [30].

As demonstrated by earlier studies, the integration of gaming technology in campus virtual tours can enhance the experience and satisfaction of users. For example, the use of an avatar-based interaction can be especially effective in attracting students who are digitally native and seek a social-like virtual experience. In one study [31], users can perform movements using gyroscopic inputs from their mobile devices. This capability allows users to simulate their physical presence in the virtual environment. As a form of real-time computer-mediated communication, motions performed by digital avatars are essential in establishing realistic social interaction in the virtual world [32]. The necessity for this realistic movement led to the usage of full face and body motion capture to ensure a similar experience to face-to-face interaction. In another study [33], Kinect technology was utilized to generate skeleton data of the human body with 25 joints, such as the head, left and right shoulders, and left and right hands. This data was then integrated into the virtual reality technology to simulate real human movements (e.g., walking and turning around). Overall, the integration of game technology is a promising approach.

III. Materials and Methods

A. Project Overview

The campus virtual tour application that we developed is part of a larger educational technology project called MILES Virtual World. This project is an attempt to build an online multiplayer metaverse-inspired video game where student life is recreated in a digital counterpart of the real world. Unlike this project, its lite version (hereinafter referred to as MILES Virtual Tour) is only a single-player game with the sole purpose of touring the virtual world (i.e., game environment). Both applications showcase 3D virtual environments that are the exact replicas of the university campuses, including specialized facilities (Figure 3), classrooms (Figure 4), and common areas (e.g., study areas) (Figure 5).

Fig. 2. Mechanical Engineering Laboratory.

Fig. 3. Computer Laboratory.

Fig. 4. Study Area.

As presented in the sample screenshots, users can explore the campuses through a third-person perspective. Inspired by video games, viewing the virtual world from this perspective provides a wider field of view that consequently allows users to see more of the virtual surroundings and to better assess the distances and extrapolate the trajectory of digital objects [34]. Meanwhile, the representation of users in the virtual world is through avatars that are already predetermined in the MILES Virtual Tour. Although self-representation is a vital feature in a digital environment [35], customizable 3D avatars are only available in the MILES Virtual World. Nevertheless, both applications were developed in Unity and coded using C# programming language [36, 37].

Fig. 5. Beta Test of the Campus Virtual Tour with Enrolled Students.

B. Beta Tests

Prior to the main evaluation, we conducted several beta tests to gather data on the initial acceptance of the application. In one of the events (See Figure 5), we recruited enrolled students since they know the layouts and designs of the campuses very well. It was also intended to assess the capability of the server to handle multiple players at one time and gather feedback on the features expected by students in the MILES Virtual World version. There was also a survey at the end of the playtest to measure different game metrics, which was participated by 144 game testers. Our assessment revealed that the initial loading time (n = 65; 45.1%) and loading time per scene (n = 95; 66.0%) were less than five seconds. Most of the students believed that the game interface is appropriate for this application (n = 66; 45.8%) and that it is easy to navigate and well-presented (n = 61; 42.4%). However, most of them are unsure whether the 3D assets are appealing (n = 48; 33.3%) and the animations are natural-looking (n = 49; 34.0%). Overall, this preliminary rating served as useful evidence [38] to improve both MILES Virtual World and Virtual Tour. We also gathered qualitative feedback on how to improve the game:

> *It needs to have a running feature but in only selected places of the school or any form of way to walk faster inside the building because the building is too big to explore.* – S41

> *I hope there would be a map for every campus and can have a teleportation option since the surface area is huge.* – *S86*

> *I recommend that before we officially take our tour, a character or a text may inform us of the details of the facilities or the campus as a whole.* – *S141*

C. Game Evaluation

In this study, we conducted another round of evaluation but with a specific emphasis on the technology acceptance using the extended TAM framework proposed in the evaluation of virtual and augmented realities [39]. This theoretical model utilizes the core constructs of TAM, such as perceived usefulness, perceived ease of use, attitude, and behavioral intention with additional factors such as hedonic motivation and perceived price value. In the field of information system research, technology acceptance is a critical aspect as it assists organizations to understand how individuals adopt and utilize new technology [40]. The extended TAM model is applicable in this study since games can also be viewed from an information system perspective [41].

Fig. 6. Campus Selection Game Interface.

D. Procedures and Data Analysis

After several game revisions following the suggestions from the beta tests, we recruited information technology students who specialized in animation and game development to evaluate the latest game build and represent the sample of enrolled students. In addition, we adopted a chain referral sampling and convinced these students to invite their friends and relatives (as the second sample) to also assess the game. This strategy was employed to capture the perspectives of both enrolled and potential students. To compare their evaluations, we utilized Mann-Whitney U Test. We also used the Spearman Rank-Order Correlation Coefficient to measure the strength and direction of association between the extended TAM constructs. We also utilized the Chi-square test of Independence to evaluate whether experience and familiarity with the campus virtual tour are significantly different between enrolled and potential students. Descriptive statistics were also used to summarize the ratings given to the TAM constructs.

IV. Results and Discussion

The goal of this study was to develop an interactive campus virtual tour application and evaluate its technology acceptance. A total of 52 enrolled students and 52 potential students ($n = 104$) participated in the game evaluation. Most of the participants are familiar with the concept of a virtual tour ($n = 81$; 77.89%), but only less than a quarter ($n = 23$; 22.12%) have actual experience in using this technology. The chi-square tests showed that there was no significant difference in terms of familiarity ($\chi^2 = 1.396$, $p = .237$) and experience ($\chi^2 = 0.056$, $p = .813$) between the two groups. These findings imply that the campus virtual tour is not that ubiquitous which could warrant a significant difference.

TABLE I. Mann Whitney-U Test Results

Constructs	Groups	Mean	SD	*U*	*p*
Perceived Ease of Use	Enrolled Potential	4.77 4.33	.625 .486	1170.0	.135
Perceived Usefulness	Enrolled Potential	4.10 4.83	.534 .383	471.5	.000
Attitude	Enrolled Potential	4.81 4.71	.398 .457	1222.0	.254
Hedonic Motivation	Enrolled Potential	4.69 4.87	.673 .397	1235.0	.225
Perceived Price Value	Enrolled Potential	4.73 4.90	.564 .298	1188.5	.090
Behavioral Intention	Enrolled Potential	4.04 4.81	.593 .445	479.0	.000

In terms of the extended TAM constructs, we noticed mixed findings (See Table 1) in the game evaluation between enrolled and potential students. The non-significant results were evident in the perceived ease of use ($U = 1170.0$, $p = .135$), attitude ($U = 1222.0$, $p = .254$), hedonic motivation ($U = 1235.0$, $p = .225$), and perceived price value ($U = 1185.5$, $p = .090$) constructs. On the other hand, only perceived usefulness ($U = 471.5$, $p = .000$) and behavioral intention ($U = 479.0$, $p = .090$) were significantly different between the groups. One obvious reason why potential students ($4.83 \pm .38$), compared to enrolled students ($4.10 \pm .53$), categorized virtual campus tours as more useful is because they have probably not visited the campuses yet or seen the facilities. A virtual campus tour permits them to gain access to the location from anywhere and without the constraints of time or travel. It is also the safer option for people to go outside and navigate the campus during the COVID-19 pandemic [42, 43]. These reasons may also explain why potential students ($4.42 \pm .65$) were more willing to use this technology than enrolled students ($4.04 \pm .59$). From a TAM perspective, perceived usefulness is a predictor of behavioral intention [40]. As presented in Table 2, we also found that perceived usefulness and behavioral intention have a strong positive correlation ($r = .686$, $p < .01$). These findings suggest a necessity for schools to adopt a campus virtual tour technology, especially to serve and attract potential students.

TABLE II. Summary of Correlation Analysis

Constructs	PEOU	PU	ATT	HM	PPV	BI
PEOU	-					
PU	.197*	-				
ATT	.027	-.099	-			
HM	.084	-.023	-.056	-		
PPV	.005	.144	.002	-.048	-	
BI	.182	.686**	-.194*	.091	.120	-

Note: PEOU = Perceived Ease of Use; PU = Perceived Ease of Use; ATT = Attitude; HM = Hedonic Motivation; PPV = Perceived Price Value; BI = Behavioral Intention. * = Correlation is significant at the 0.05 level (2-tailed) and ** = correlation is significant at the 0.01 level (2-tailed).

In addition to the perceived usefulness construct, attitude is also an essential factor since it has a significant relationship with behavioral intention (see Table 2). Their association is regarded as important in the fields of information technology and human-computer interaction as it helps to explain why people adopt and use technology. For example, studies have shown that a positive attitude toward any technology is associated with a higher level of perceived usefulness [44, 45]. In other words, users who have favorable attitudes are more likely to believe that using it will be beneficial to them. From a managerial perspective, schools must implement strategies that can elicit a positive attitude. One idea is to nurture a culture that values and encourages technology use [46]. This strategy will create a modern and technology-forward institutional image, one that carries a commitment to innovation and progress. Another approach to encourage a positive attitude is making the technology available to as many people as possible. In our case, MILES Virtual Tour is playable through a range of devices and platforms which aids to boost its reach and impact.

Unlike most studies on technology acceptance research [e.g., 40], perceived ease of use did not have a significant relationship with behavioral intention. However, it is still significantly linked to perceived usefulness, which poses important implications. If people find technology complicated to operate, they may be less likely to believe that it will vastly improve their performance or personal life. On the other hand, if they find it easy to use, they are more likely to believe that it will be useful [47-49]. As shown in Table 2, perceived usefulness has a strong positive significant relationship with behavioral intention. Likewise, both constructs are significant predictors of attitude toward technology [50]. The higher ratings given by enrolled students ($4.77 \pm .63$), compared to potential students ($4.33 \pm .49$), to perceived ease of use were anticipated since they are enrolled in an information technology degree specializing in animation game development. Meanwhile, one advantage of MILES Virtual Tour is its independence in the usage of virtual reality headsets. For instance, using Oculus Rift head-mounted displays decreases telepresence because users are experiencing physical impediments (e.g., cyber sickness).

V. Conclusion

In this study, we developed and evaluated a playable virtual tour showcasing school facilities to create an interactive campus visit experience. From a technological perspective, we designed and developed MILES Virtual Tour using game technology as it allows for a more immersive experience compared to traditional virtual tours (e.g., 360 videos) that only provide a passive view of the environment. Our results showed that the application was well-received by prospective students and was deemed useful in providing an immersive campus visit experience. Thus, schools should consider the implementation of 3D virtual tours as a tool to improve their student recruitment strategies. Future research may investigate whether this technology significantly influences students' decision-making process when choosing a school. For our research project, the next step is to transform MILES Virtual Tour into a complete online multiplayer metaverse video game. MILES Virtual World will feature customizable virtual avatars and real-world activities simulated in the virtual environment. In summary, this study highlights the potential of 3D virtual tours in creating an interactive campus visit experience and paves the way for the future developments of our metaverse project.

Acknowledgment

The authors express their sincere thanks to the FEU Institute of Technology for funding the project through the grant awarded by Accenture as well as to students who participated in the study.

References

[1] N. Frølich, S. Brandt, E. Hovdhaugen, and P. O. Aamodt, "Coping by Copying? Higher Education Institutions' *Student Recruitment Strategies," Tertiary Education and Management*, vol. 15, no. 3, pp. 227-240, 2009, doi: 10.1080/13583880903072992.

[2] A. Y. Akbulut and C. A. Looney, "Improving IS Student Enrollments: Understanding the Effects of IT Sophistication in Introductory IS Courses," Journal of Information Technology Education, vol. 8, pp. 87-100, 2009. [Online]. Available: https://eric.ed.gov/?id=EJ830517.

[3] M. B. Garcia and P. S. Garcia, "Intelligent Tutoring System as an Instructional Technology in Learning Basic Nutrition Concepts: An Exploratory Sequential Mixed Methods Study," in *Instructional Technologies in Health Education and Allied Disciplines*, M. B. Garcia, M. V. López-Cabrera, and R. P. P. de Almeida Eds. USA: IGI Global, 2023, doi: 10.4018/978-1-6684-7164-7.ch012.

[4] R. S. d. Almeida, "Redefining Health Education in the Post-Pandemic World: How to Integrate Digital Technologies into the Curricula?," in *Instructional Technologies in Health Education and Allied Disciplines*, M. B. Garcia, M. V. López-Cabrera, and R. P. P. de Almeida Eds. USA: IGI Global, 2023, doi: 10.4018/978-1-6684-7164-7.ch001.

[5] A. Tomé and J. L. Coelho, "Physiotherapy Education in the Digital Era: A Roadmap of Educational Technologies for Allied Health Educators," in *Instructional Technologies in Health Education and Allied Disciplines*, M. B. Garcia, M. V. López-Cabrera, and R. P. P. de Almeida Eds. USA: IGI Global, 2023, doi: 10.4018/978-1-6684-7164-7.ch002.

[6] P. Y. Talbert, "Strategies to Increase Enrollment, Retention, and Graduation Rates," *Journal of Developmental Education*, vol. 36, no. 1, pp. 22-36, 2012. https://files.eric.ed.gov/fulltext/EJ1035683.pdf.

[7] N. Frølich and B. Stensaker, "Student Recruitment Strategies in Higher Education: Promoting Excellence and Diversity?," *International Journal of Educational Management*, vol. 24, no. 4, pp. 359-370, 2010, doi: 10.1108/09513541011045281.

[8] B. Z. Butt and K. u. Rehman, "A Study Examining the Students Satisfaction in Higher Education," *Procedia - Social and Behavioral Sciences*, vol. 2, no. 2, 2010, doi: 10.1016/j.sbspro.2010.03.888.

[9] B. Kittle and D. Ciba, "Using College Web Sites for Student Recruitment: A Relationship Marketing Study," *Journal of Marketing for Higher Education*, vol. 11, no. 3, pp. 17-37, 2001, doi: 10.1300/J050v11n03_02.

[10] V. Naidoo and T. Wu, "Marketing Strategy Implementation in Higher Education: A Mixed Approach for Model Development and Testing," *Journal of Marketing Management*, vol. 27, no. 11-12, pp. 1117-1141, 2011, doi: 10.1080/0267257X.2011.609132.

[11] M. B. Garcia, "Location-Based Marketing Using Mobile Geofencing: Lessons Learned from a User-Centered Application Development Research," *International Journal of Technology Marketing*, vol. 17, no. 1, pp. 1-29, 2022, doi: 10.1504/IJTMKT.2022.10047566.

[12] I. Gabelaia, "Scholarships as Components of Marketing and Recruiting Strategy," in *Reliability and Statistics in Transportation and Communication*, Cham, I. Kabashkin, I. Yatskiv, and O. Prentkovskis, Eds., 2022: Springer, pp. 608-617, doi: 10.1007/978-3-030-96196-1_55.

[13] J. M. S. Gross, S. J. Haines, C. Hill, G. L. Francis, M. Blue-Banning, and A. P. Turnbull, "Strong School-Community Partnerships in Inclusive Schools Are "Part of the Fabric of the School... We Count on Them"," *The School Community Journal*, vol. 25, pp. 9-34, 2015. [Online]. Available: https://eric.ed.gov/?id=EJ1085646.

[14] E. Swanson, K. Kopotic, G. Zamarro, J. N. Mills, J. P. Greene, and G. W. Ritter, "An Evaluation of the Educational Impact of College Campus Visits: A Randomized Experiment," *AERA Open*, vol. 7, pp. 1-18, 2021/01/01 2021, doi: 10.1177/2332858421989707.

[15] M. C. Smith, R. M. Gosky, and J.-T. Li, "Campus Visits as Predictors of Postsecondary Enrollment in Low-Income, Rural School Districts," *Journal of College Access*, vol. 7, no. 1, pp. 130-144, 2022. [Online]. Available: https://eric.ed.gov/?id=EJ1345622.

[16] M. B. Garcia, L. S. Nadelson, and A. Yeh, ""We're going on a virtual trip!": A Switching-Replications Experiment of 360-Degree Videos as a Physical Field Trip Alternative in Primary Education," *International Journal of Child Care and Education Policy*, vol. 17, no. 4, pp. 1-16, 2023/01/25 2023, doi: 10.1186/s40723-023-00110-x.

[17] A. S. b. Azizo, F. b. Mohamed, C. V. Siang, and M. I. M. Isham, "Virtual Reality 360 UTM Campus Tour with Voice Commands," presented at the 2020 6th International Conference on Interactive Digital Media (ICIDM), 2020, doi: 10.1109/ICIDM51048.2020.9339665.

[18] M. B. Garcia, "Augmented Reality in History Education: An Immersive Storytelling of American Colonisation Period in the Philippines," *International Journal of Learning Technology*, vol. 15, no. 3, pp. 234-254, doi: 10.1504/IJLT.2020.112170.

[19] N. Maiellaro, A. Varasano, and S. Capotorto, "Digital Data, Virtual Tours, and 3D Models Integration Using an Open-Source Platform," presented at the *VR Technologies in Cultural Heritage*, Cham, 2019.

[20] C. Maines and S. Tang, "An Application of Game Technology to Virtual University Campus Tour and Interior Navigation," presented at the *2015 International Conference on Developments of E-Systems Engineering* (DeSE), 2015, doi: 10.1109/DeSE.2015.15.

[21] R. B. Rohizan, D. M. Vistro, and M. R. B. Puasa, "Enhanced Visitor Experience Through Campus Virtual Tour," *Journal of Physics: Conference Series*, 2019, doi: 10.1088/1742-6596/1228/1/012067.

[22] T. Kusu et al., "A Virtual Campus Tour Service Using Remote Control Robots on Robot Service Network Protocol," presented at the *2013 27th International Conference on Advanced Information Networking and Applications Workshops*, 2013, doi: 10.1109/WAINA.2013.160.

[23] M. Fujita, Y. Tokiwa, O. Ohashi, and Y. Kato, "A Virtual Campus Tour Service Using Mobile Robots," presented at the *2014 28th International Conference on Advanced Information Networking and Applications Workshops*, 2014, doi: 10.1109/WAINA.2014.55.

[24] N. Gasteiger, K. Loveys, M. Law, and E. Broadbent, "Friends from the Future: A Scoping Review of Research into Robots and Computer Agents to Combat Loneliness in Older People," *Clinical Interventions in Aging*, vol. 16, pp. 941-971, 2021, doi: 10.2147/cia.S282709.

[25] A. D. Samala, F. Ranuharja, B. R. Fajri, Y. Indarta, and W. Agustiarmi, "ViCT—Virtual Campus Tour Environment with Spherical Panorama: A Preliminary Exploration," Inte*rnational Journal of Interactive Mobile Technologies*, vol. 16, no. 16, 2022, doi: 10.3991/ijim.v16i16.32889.

[26] T. L. M. Suryanto and N. C. Wibowo, "Developing and Evaluating a Jejakatua Virtual Campus Tour Prototype Using Auto-stitching Technique," *Journal of Physics: Conference Series*, vol. 1569, no. 2, pp. 1-6, 2020, doi: 10.1088/1742-6596/1569/2/022055.

[27] T. Widiyaningtyas, D. D. Prasetya, and A. P. Wibawa, "Web-Based Campus Virtual Tour Application using ORB Image Stitching," presented at the *5th International Conference on Electrical Engineering, Computer Science and Informatics*, 2018, doi: 10.1109/EECSI.2018.8752709.

[28] A. W. Liang, N. Wahid, and T. Gusman, "Virtual Campus Tour Application Through Markerless Augmented Reality Approach," *International Journal on Informatics Visualization*, vol. 5, no. 4, pp. 354-359, 2021, doi: 10.30630/joiv.5.4.743.

[29] C. Andri, M. H. Alkawaz, and A. B. Sallow, "Adoption of Mobile Augmented Reality as a Campus Tour Application," *International Journal of Engineering & Technology*, vol. 7, no. 4, pp. 64-69, 2018, doi: 10.14419/ijet.v7i4.11.20689.

[30] T.-L. Chou and L.-J. ChanLin, "Augmented Reality Smartphone Environment Orientation Application: A Case Study of the Fu-Jen University Mobile Campus Touring System," *Procedia - Social and Behavioral Sciences*, 2012, doi: 10.1016/j.sbspro.2012.05.132.

[31] A. Razia Sulthana, A. Arokiaraj Jovith, D. Saveetha, and A. K. Jaithunbi, "A Game Based Virtual Campus Tour," *Journal of Physics: Conference Series*, vol. 1000, no. 1, pp. 1-5, 2018, doi: 10.1088/1742-6596/1000/1/012131.

[32] S. L. Rogers, R. Broadbent, J. Brown, A. Fraser, and C. P. Speelman, "Realistic Motion Avatars are the Future for Social Interaction in Virtual Reality," *Frontiers in Virtual Reality*, vol. 2, pp. 1-12, 2022, doi: 10.3389/frvir.2021.750729.

[33] S. Tsujinaga, N. Yamaguchi, J. Liu, T. Tateyama, Y. Iwamoto, and Y. W. Chen, "Interactive Virtual Campus Tour System Using Skeleton Information from Kinect," presented at the *2018 IEEE 7th Global Conference on Consumer Electronics (GCCE)*, 2018, doi: 10.1109/GCCE.2018.8574856

[34] P. Salamin, D. Thalmann, and F. Vexo, "The Benefits of Third-Person Perspective in Virtual and Augmented Reality," presented at the ACM Symposium on Virtual Reality Software and Technology, New York, USA, 2006, doi: 10.1145/1180495.1180502.

[35] D. Zimmermann, A. Wehler, and K. Kaspar, "Self-Representation Through Avatars in Digital Environments," *Current Psychology*, pp. 1-15, 2022/06/04 2022, doi: 10.1007/s12144-022-03232-6.

[36] M. B. Garcia, R. T. Adao, E. B. Pempiña, C. K. Quejado, and C. R. B. Maranan, "MILES Virtual World: A Three-Dimensional Avatar-Driven Metaverse-Inspired Digital School Environment for FEU Group of Schools." https://manuelgarcia.info/publication/miles-virtual-world.

[37] M. B. Garcia, R. T. Adao, O. N. Ualat, and A. Cunanan-Yabut, "Remodeling a Mobile Educational Metaverse Using a Co-Design Approach: Challenges, Issues, and Requested Features." Available: https://manuelgarcia.info/publication/mobile-educational-metaverse.

[38] M. B. Garcia, J. B. Mangaba, and C. C. Tanchoco, "Virtual Dietitian: A Nutrition Knowledge-Based System Using Forward Chaining Algorithm," presented at the *2021 International Conference on Innovation and Intelligence for Informatics, Computing, and Technologies (3ICT)*, 2021, doi: 10.1109/3ICT53449.2021.9581887.

[39] S. Shen, K. Xu, M. Sotiriadis, and Y. Wang, "Exploring the Factors Influencing the Adoption and Usage of Augmented Reality and Virtual Reality Applications in Tourism Education within the Context of COVID-19 Pandemic," *Journal of Hospitality, Leisure, Sport & Tourism Education*, vol. 30, pp. 1-12, 2022, doi: 10.1016/j.jhlste.2022.100373.

[40] M. B. Garcia, "Factors Affecting Adoption Intention of Productivity Software Applications Among Teachers: A Structural Equation Modeling Investigation," *International Journal of Human–Computer Interaction*, 2023, doi: 10.1080/10447318.2022.2163565.

[41] G. Xexéo, E. Mangeli, F. Silva, L. Ouriques, L. F. C. Costa, and R. S. Monclar, "Games as Information Systems," presented at the XVII Brazilian Symposium on Information Systems (SBSI 2021), New York, USA, 2021, doi: 10.1145/3466933.3466961.

[42] M. B. Garcia, "Sentiment Analysis of Tweets on Coronavirus Disease 2019 (COVID-19) Pandemic from Metro Manila, Philippines," *Cybernetics and Information Technologies*, vol. 20, no. 4, pp. 141-155, 2020, doi: doi:10.2478/cait-2020-0052.

[43] H. N. H. Dybsand, "'The next best thing to being there' – Participant Perceptions of Virtual Guided Tours Offered During the COVID-19 Pandemic," *Current Issues in Tourism*, pp. 1-14, 2022, doi: 10.1080/13683500.2022.2122417.

[44] M. Lee, S. A. Lee, M. Jeong, and H. Oh, "Quality of Virtual Reality and Its Impacts on Behavioral Intention," *International Journal of Hospitality Management*, vol. 90, pp. 1-9, 2020, doi: 10.1016/j.ijhm.2020.102595.

[45] A. S. Mustafa and M. B. Garcia, "Theories Integrated with Technology Acceptance Model (TAM) in Online Learning Acceptance and Continuance Intention: A Systematic Review," presented at the *2021 1st Conference on Online Teaching for Mobile Education (OT4ME)*, 2021, doi: 10.1109/OT4ME53559.2021.9638934.

[46] M. B. Garcia, "Fostering an Innovation Culture in the Education Sector: A Scoping Review and Bibliometric Analysis of Hackathons," *Innovative Higher Education*, 2023, doi: 10.1007/s10755-023-09651-y.

[47] Y. He, Q. Chen, and S. Kitkuakul, "Regulatory Focus and Technology Acceptance: Perceived Ease of Use and Usefulness as Efficacy," *Cogent Business & Management*, 2018, doi: 10.1080/23311975.2018.1459006.

[48] J. Cabero-Almenara, J. M. Fernández-Batanero, and J. Barroso-Osuna, "Adoption of Augmented Reality Technology by University Students," *Heliyon*, vol. 5, no. 5, pp. 1-9, 2019, doi: 10.1016/j.heliyon.2019.e01597.

[49] R. Iftikhar, M. S. Khan, and K. Pasanchay, "Virtual Reality Tourism and Technology Acceptance: A Disability Perspective," *Leisure Studies*, pp. 1-17, 2022, doi: 10.1080/02614367.2022.2153903.

[50] M. Fagan, C. Kilmon, and V. Pandey, "Exploring the Adoption of a Virtual Reality Simulation," *Campus-Wide Information Systems*, vol. 29, no. 2, pp. 117-127, 2012, doi: 10.1108/10650741211212368.