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Science education using Kaanbale virtual reality

Enseñanza de las ciencias utilizando Kaanbale realidad virtual

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Abstract

Virtual Reality (VR) is an emerging technology that has gained a significant role in the instruction of science because in contrast to text and face to face learning, has a positive impact on their contents learning, generating positive emotions for comprehending physics concepts. Kaanbale is a Virtual Reality system designed with Kanban and MeISE methodologies that provides an captivating and immersive experience for students and allows them to view and understand science subjects and topics through a personal virtual environment. The concept used in this work was Uniform Motion, which is defined as the motion of an object in which the object travels in a straight line and its velocity remains constant along that line as it covers equal distances in equal intervals of time, irrespective of the duration of the time; but through Kaanbale is possible simulate other physics motion concepts like uniformly acceleration, parabolic and free-fall. This paper intends to demonstrate that the immersion and engagement that high school students gain from Kaanbale VR significantly enhances their ability to understand and retain information.

Virtual Reality, Simulator, Emerging Technology

Resumen

La Realidad Virtual (VR) es una tecnología emergente que ha ganado un papel sustancial en la enseñanza de las ciencias, porque a diferencia del aprendizaje presencial o a partir de textos, tiene un impacto positivo en el aprendizaje de sus contenidos, generando emociones positivas para la comprensión de los conceptos de física. Kaanbale es un sistema de Realidad Virtual diseñado con las metodologías Kanban y MeISE que brinda una experiencia atractiva e inmersiva para los estudiantes y les permite ver y comprender materias y conceptos científicos a través de un entorno virtual personal. El concepto utilizado en este trabajo fue el Movimiento. Rectilíneo Uniforme, que se define como el movimiento de un objeto que se desplaza en línea recta y su velocidad permanece constante a lo largo de esa línea mientras recorre distancias iguales en intervalos iguales de tiempo; cabe destacar que a través de Kaanbale es posible simular otros conceptos de movimiento como el movimiento uniformemente acelerado, el tiro parabólico y la caída libre. Este trabajo tiene como objetivo mostrar que la inmersión y el compromiso que los estudiantes de preparatoria obtienen con Kaanbale RV aumenta considerablemente su capacidad para comprender y retener información.

Realidad virtual, Simulador, Tecnología emergentes

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Introduction

Physics is a science discipline considered by high school students as the most challenging subject (Trumper, 2006). This preconceived notion that physics is a demanding course has impacted the performance of students in physics, which is well-known for a lack of enthusiasm towards learning physics concepts (Guido, 2013).

Bozalek and colleagues (2013) explored how emerging technologies are utilized in innovative pedagogical practices to revolutionize teaching and learning across higher education institutions. Some emerging technologies include blockchain (Shah, 2021), internet of things (Suaad, 2023) and Virtual Reality (Hamilton, 2021).

Virtual Reality (VR) has been highly recommended as a significant development in emerging technology that can support the teaching-learning process. Students can virtually engage with the content provided to carry out real-life activities, and it is possible to present dynamic scenarios as in real life (Daniela & Lytras, 2019). In this way, students can experience an event firsthand and enhance their knowledge more effectively than in non-VR environments (Jeong, 2020).

Universidad Tecnológica Cadereyta introduced Kaanbale, an interactive learning environment utilizing Virtual Reality, to inspire students in their understanding of physics concepts that are not easily attainable through traditional methods.

Methodology

The project aims to create a simulator to facilitate the process of teaching and learning in the field of science, starting with Uniform Motion with the assistance of Virtual Reality technology. It has been observed that subjects like Chemistry and Physics pose challenges for students to comprehend at any grade level (Ahmed et al., 2022), hence there is a need to innovate new methods of teaching and learning using emerging technologies, such as immersive ones. For the realization of this project, the Educational Software Engineering Methodology “MeISE” (Abud, 2009) serves as a point of reference, which proposes a life cycle divided into two stages:

The initial stage encompasses the definition of requirements and the preliminary analysis and design, during which the desired characteristics of the product, the pedagogical and communication requirements, and the overall software architecture are determined; It concludes with an iteration plan carefully programmed to ensure that the product released at the end of each iteration is fully comprehensive, covering specific educational objectives. Once these guidelines are established, the second stage commences, in which the product is developed. The team takes each iteration, designs it, builds it, tests it, and implements it, evaluating the feasibility of continuing with subsequent iterations until a complete product is achieved" (Abud, 2009). For the development of Kaanbale, the MeISE methodology was combined with Kanban Agile methodologies (Leon & Checa, 2022) according to the diagram depicted below.

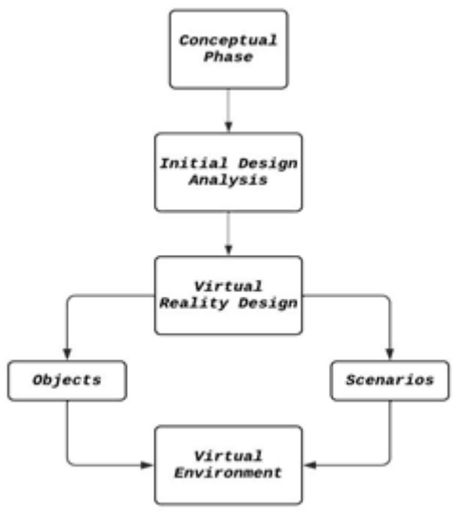

Figure 1 Kaanbale process diagram

Experimental

The Kaanbale Simulator has been created according to the process diagram shown in Figure 1. In the conceptual phase, the Uniform Motion was defined. In the initial design analysis phase, the requirements were established, where the Unity real-time development platform will be utilized, along with the design of the object and scenario models that will be worked on in Autodesk Maya software. The scripts generated in the C# language were also specified, which will execute the actions of each object. They will be exported to Unity (Unity, 2023) for development in the virtual environment for Uniform Motion through a menu with a graphical interface.

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In the virtual reality design phase, the objects were modeled in Autodesk Maya software, where measurements were taken from different vehicles such as a golf cart, a Volkswagen, a motorcycle, among others. These will act as the foundation for the simulation of Straight-line Constant Velocity. Then, the scenarios were created where the distances to extract the necessary data for the simulation will be covered. Afterwards, the scripts in C# are programmed, defining within each of them the actions so that the formulas calculate the values of the established variables of Uniform Motion in the objects. Finally, the login menu for the simulator was designed.

To accomplish the virtual environment phase, the Kanbale system is implemented. To make it feasible, the student will don virtual reality goggles produced by Oculus and utilize 2 Touch controllers. Subsequently, the application is executed from the computer (refer to Figure 2), showcasing the menu.

First, the operator selects the Physics topic, in this case, it is Uniform Motion. The next step is to choose the object with the Touch controllers, whether it is a car, a golf cart, or a motorcycle, with which the student wants to simulate the Uniform Motion exercise. Then, is necessary to input the values of the formula, according to which the Simulation will be performed. Finally, the user is placed in the scenario so that the undergraduate has the immersive experience and achieves meaningful learning with it.

Figure 2 Implementation of the Kaanbale system

Results

When executing the Kaanbale system, the initial display that is observed through the virtual glasses is depicted in Figure 3. The user must select the "Uniform Motion" choice from the simulation panel situated on the left-hand side.

Figure 3 Primary display of the simulator

Afterwards, the user should choose the item they want to use for the simulation. These choices are displayed in figure 4.

Figure 4 Object selection for performing the MRU simulation

Following the vehicle selection, the simulator will present a window (refer to figure 5) where the values of the identified variables need to be inputted in order to execute the application.

Figure 5 Inputting data into variables for the Execution of Simulation

The figures 6, 7, 8 and 9 show the different camera placements to view the starting point of diverse object models.

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Figure 6 General overview position

Figure 7 Subjective angle position

Figura 8 High angle position

Figura 9 Top view position

After finishing the simulation, the program shows the object from different camera positions, as can be seen in figures 10 and 11.

Figure 10 Final view of uniform motion simulation

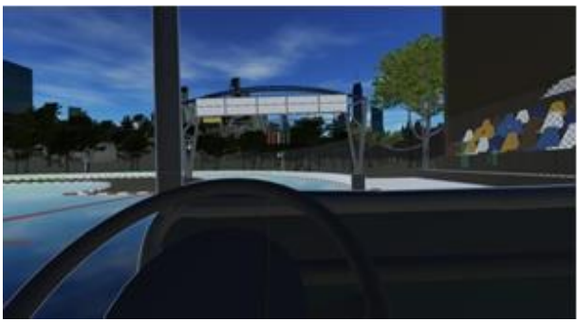

Figure 11 Final view simulation

The various camera angles contribute to the immersion of the student in the virtual world of Kaanbale, sparking curiosity in the physics subject being explored.

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Conclusions

At the end of this project, the Virtual Reality Simulator Kaanbale was developed, which enables students to be fully immersed in solving problems in the field of Physics related to Uniform Motion. This immersive experience enhances the learning process, improves understanding and retention of information, and ignites interest in the subject of physics, overcoming the general lack of enthusiasm towards the topic.

A future opportunity lies in expanding the simulator to include additional topics in Physics, such as Projectile Motion, Free Fall, Uniformly Accelerated Motion, and even other areas of knowledge, providing students with a highly interactive learning experience.

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References

Abud Figueroa M.A. (2009). MeISE: Metodología de Ingeniería de Software Educativo. Revista Internacional de Educación en Ingeniería 2, 1: 10-18. [online] Available: http://www.academia.edu/6834077/P_a_g_i_n_a_MeISE_Metodología_de_Ingeniería_de_Software_Educativo

Ahmed, S., Tukur, U. & Ahmad, M. (2022). Effect of Virtual Reality-Based Instructional Strategy on Secondary School students in physics in Dutsin-Ma educational quality assurance zone, Katsina state. Al-Hikmah Journal of Education, 9, 2, 157-164. [online] Available:https://alhikmahuniversity.edu.ng/centralJournal/my_portal/user/event/bookUrl521.pdf

Bozalek, V.G., Ng'ambi, D., and Gachago, D. (2013). Transforming teaching with emerging technologies: Implications for higher education institutions. [online] Available: https://journals.co.za/doi/epdf/10.10520/EJC144269

Daniela, L. and Lytras, M.D. (2019). Editorial: themed issue on enhanced educational experience in virtual and augmented reality. Virtual Reality 23, 325–327. https://doi.org/10.1007/s10055-019-00383-z

Guido, R. M. D. (2013). Attitude and motivation towards learning physics. International Journal of Engineering Research & Technology (IJERT) 2, 11, 2087-2093. [online] Available:

Hamilton, D., McKechnie, J., Edgerton, E. et al. (2021) Immersive virtual reality as a pedagogical tool in education: a systematic literature review of quantitative learning outcomes and experimental design. J. Comput. Educ. 8, 1–32. https://doi.org/10.1007/s40692-020-00169-2.

Jeong, S.H., Kim, S., Yum, J-Y. and Hwang, Y. (2020). Effects of virtual reality news on knowledge gain and news attitudes. International Journal of Mobile Communications. 18:3, 300-313. https://doi.org/10.1504/IJMC.2020.107098

León Yacelga, A. R.,& Checa Cabrera, M. A.(2022).Uso de tableros Kanban como apoyo para el desarrollo de las metodologías ágiles. Revista Universidad y Sociedad,14(S2),208-214. [online] Available: https://rus.ucf.edu.cu/index.php/rus/article/view/2760/2735

Shah, D., Patel, D., Adesara, J. et al. (2021). Exploiting the Capabilities of Blockchain and Machine Learning in Education. Augment Hum Res 6, 1. https://doi.org/10.1007/s41133-020-00039-7

Suaad, H.H.A., Kanber, H.A. and Al-Dulaimi W.A.M. (2023) "The importance of using the internet of things in education," International Journal of Emerging Technologies in Learning (iJET), vol. 18, no. 01, pp. 19–39. https://doi.org/10.3991/ijet.v18i01.35999

Trumper, R. (2006). Factors Affecting Junior High School Students' Interest in Physics. Journal of Science Education and Technology, 15, 47–58, https://doi.org/10.1007/s10956-006-0355-6

"Unity Learn", January 2023, [online] Available: https://learn.unity.com/pathway/vrdevelopment.

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