

## Retraction

# Retracted: An Artificial Intelligent Virtual Reality Interactive Model for Distance Education

### Journal of Mathematics

Received 19 December 2023; Accepted 19 December 2023; Published 20 December 2023

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

- (1) Discrepancies in scope
- (2) Discrepancies in the description of the research reported
- (3) Discrepancies between the availability of data and the research described
- (4) Inappropriate citations
- (5) Incoherent, meaningless and/or irrelevant content included in the article
- (6) Manipulated or compromised peer review

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

### References

- [1] W. Yin, "An Artificial Intelligent Virtual Reality Interactive Model for Distance Education," *Journal of Mathematics*, vol. 2022, Article ID 7099963, 7 pages, 2022.

## Research Article

# An Artificial Intelligent Virtual Reality Interactive Model for Distance Education

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Received 2 December 2021; Revised 6 January 2022; Accepted 11 January 2022; Published 14 February 2022

Academic Editor: Naeem Jan

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Information and communication technologies play an important role in education. This fact was emphasized even more due to the significant upheavals, globally, caused by the pandemic of COVID-19 and because distance education uses tools of modern technology that prove to be significantly important. Particularly, virtual reality immersion systems, which may include 3D spatial representations, multisensory interaction channels, and real-time intuitive physical interaction, can extend the learning process by providing learners with stimuli that represent a real advanced training environment. In the present work, based on the most modern technologies of computational intelligence, virtual and augmented reality, wireless communications, and space-sensitive positioning applications, an Artificial Intelligent Virtual Reality (AI-VR) interactive model for distance education is presented. This is a case study of escape-room-type educational application, wherewith appropriate practices and methodologies promote individual and collective participation, enhance the active role of the learner, personalize the educational experience, and upgrade the process of participation in distance education, strengthening and assisting role of the educator. Specifically, a Newton polynomial is used for max-polynomials arising from the stereoscopic problem of augmented reality used to indirectly indicate the number of linear regions in order to optimize the problem. The proposed application is related to the training course of agricultural education and methods of modernization of crops, including additional sound, 3D graphics, and short film projection. The history-space-objects relationship takes and evolves with various versions such as the parts of the story to be unlocked as the trainee moves from one tool to the next or the story to guide the trainee to explore the space-time continuum, giving a new dimension to the technological development of agricultural education and the methods of modernization of crops. This finding shows that they learn best when they receive information in a style that incorporates visual, auditory, and kinetic stimuli so that learning improves when learners can examine an idea or concept using a multidimensional approach.

## 1. Introduction

Following the rapid development of both computer hardware technology and software capabilities in the last decade, a new trend is emerging today that places particular emphasis on human-machine interaction. Virtual reality, which is a key representative of this new trend, is a means for people to visualize, manage, and interact with computer systems as well as extremely complex data in a virtual environment. The result produced by a virtual reality system is called a virtual environment, which is based in part or whole on data generated by a computer system. The goal of the virtual environment is to create to the user the illusion that he is naturally placed in a synthetically produced

environment, through his representation (embodiment) by an entity.

Regarding the application of multimedia in education, there is the view that information that circulates in the form of direct experience using different senses, as opposed to reading, which is a purely visual and mental process, maintains and cultivates its correlations. This is one of the reasons that educational multimedia applications manage to convey more quality information to their users, as has been proven in practice. Based on this view, the use of virtual reality systems in educational applications further engages the user in the learning process, offering him various options for exploring the cognitive space and leading to a more efficient educational process.

The main advantage of virtual reality is its ability to facilitate constructive learning activities and to provide alternative forms of learning that can help different types of students (e.g., visual-type students). They also offer the possibility of educational use of shared virtual spaces (or network virtual environments) [1–3] for distance learning and collaborative learning. Such applications can be used as collaboration and training tools, as they can allow students and teachers to take part in virtual meetings, seminars, and lectures in real time.

In general, virtual reality technology can be used in a variety of ways to support the educational process [4], especially in cases where traditional teaching methods are not sufficient, such as the following:

- (1) *Simulation of Complex Systems*. The advantage over traditional teaching methods is the ability of learners to observe the operation of the system from many angles using high-quality imaging but also to interact with it.
- (2) *Macroscopic and Microscopic Imaging* [5]. The advantage lies in the ability to observe phenomena, systems, objects, and so on, which are too small or too large to become visible or to understand their operation on a normal scale.
- (3) *Simulation of Dynamic Events* [6]. The advantage lies in the ability to observe the dynamic event through its different playback speeds. This function is equivalent to the fast forward function on a video device.

Other important features of virtual reality that can be used to support the educational process are the following:

- (1) The high level of interaction offered by virtual reality technology: most people learn through practice.
- (2) The sense of immersion: in immersive virtual reality environments, users are fully immersed in the virtual world using special input/output devices. This is a useful feature for various applications, like training in architecture where the sense of size is very important for the impact of the design of a building on the external environment and the inhabitants.
- (3) The inherent flexibility and adaptability of virtual reality systems: these features come from the nature of the software that supports the virtual environment. A virtual reality system can be used in various ways depending on the software application to be used. So, it can be used for various educational applications.

In addition to the above uses, virtual environments and more specifically the collaborative ones [7–9] offer many useful features to assist the educational process through the following:

- (1) Supporting students' social awareness
- (2) Increasing the possibility of interaction and active collaboration between students

- (3) The up-to-date and varied information available to users and the possibility for collaborative knowledge exchange
- (4) The provision of virtual experiences for the perception and understanding of complex concepts
- (5) The fusion of aspects and characteristics of direct and indirect learning.

Various proposals have been made related to the use of virtual environments and the exploitation of their advantages in education, some of which are particularly interesting:

- (1) The use of avatars [10, 11] to upgrade user presence and collaboration: virtual environments provide a sense of user presence with techniques that shift their focus from the real world to the virtual. Presence is associated with upgrading users' sense of their responsibilities as students in the virtual world, while at the same time feeling more comfortable during the educational process. This is enhanced by the sense of the presence of other users in the virtual environment, through their representation (avatars), which in addition helps the cooperation of users. In addition, the gestures and actions that can represent the avatars of users raise the awareness of other users about their actions.
- (2) The design of virtual spaces in correspondence with the real world. Virtual environments place the learning process in a virtual space with a specific purpose. The design of the virtual environment with objects and content similar to a traditional classroom seems to play an important role because of the active interaction with objects familiar to students, like a whiteboard, blackboard, presentations, etc.

Web virtual environments can be the basis for creating educational environments for collaborative distance learning over other technologies, such as video conferencing systems, because of their key advantages over other distance learning technologies. More specifically, they provide important tools for creating communication and collaboration systems with easy access and use at the same time. A fairly large number of users can communicate simultaneously through multiple channels such as voice communication, text messaging, and gestures, without the need to install additional computer hardware.

In addition, avatars provide a set of benefits, offering additional communication channels and helping users to express actions in the virtual environment. At the same time, their use is rather straightforward, which allows users to blend more easily in the general use of the system and not distract them from the educational process.

It should be noted, however, that the existing systems of virtual environments do not take full advantage of their potential in terms of user awareness of the social presence and consequently of the educational function. For this reason, in collaborative distance learning, the term "Educational Virtual Environment" is used.

An educational virtual environment seeks to harness the potential of his online nature to support flexible learning. More specifically, it is based, from a pedagogical point of view, on the concepts that govern collaborative learning and, from a technological point of view, on virtual network environments. A virtual educational environment is therefore a virtual network environment framed with additional functionalities and technologies to effectively support collaborative distance learning communities. Such features include text chat, voice communication, private messaging, application sharing, collaborative text reading, and document management, recognizing the presence of other users and representing users with humanlike avatars that support gestures related to the educational process (e.g., raising hands, pointing, applause, etc.) and observing objects and space from different angles.

Despite these promises, Educational Virtual Environment is still not perfect from technological, organizational, and psychological points of view since it suffers from a number of challenges:

- (1) AR is often considered as a game, which is not taken very much seriously—it is fun to play with, but not a real learning process. Students can show the attitude which assists in winning the game but not fully engage their mind to acquire new knowledge and critical thinking.
- (2) AR requires intensive graphics capabilities that are not at all times possible with standard computer equipment and it could take significant efforts to achieve smooth implementation and worth.
- (3) Immersion and interaction.
- (4) AR is often delivered as propriety solutions that could not be matched with similar environments from other developers—many companies offer their own tools to create VR environments that are not compatible with the rest regarding hardware and software.
- (5) AR, after its initial adoption as a new technology, will require unified standards for the preparation of professional curriculums that are compatible between different educational institutions regarding content preparation, implementation, and educational result achievement.
- (6) AR training time—depending on the size of the organization, cultural characteristics of the workforce, and the existing used methodologies, training time could be minimal or extensive.
- (7) AR training could provide participants with a higher level of realism and immersion in comparison to classroom instructions and web-based educational material. However, AR scenarios still lack the direct hands-on experience and face-to-face interactions that real-life exercises provide. The novelty of Educational Virtual Environment requires preliminary training with such environments to enable users to effectively use new systems.

In this work, based on the most modern technologies of computational intelligence, virtual and augmented reality, wireless communications, as well as space-sensitive positioning applications, an AI-VR interactive model for distance education is presented. This is a case study of escape-room-type educational application, wherewith appropriate practices and methodologies promote individual and collective participation, enhance the active role of the learner, personalize the educational experience, and upgrade the process of participation in distance education, strengthening and assisting role of the educator.

The study is organized as follows: Section 2 gives a detailed description of the related review of the topic. Section 3 presents the proposed AI-VR interactive model. Section 4 has a discussion on our study, and finally, the last section draws the conclusions and outlines future research directions.

## 2. Related Literature

The literature of Artificial Intelligence research in E-Learning, especially in recent years, is becoming more and more frequent because of the great potential of AI in the field of the educational process and especially the personalization aspect.

Montebello [12] presented a comprehensive picture of AI in E-Learning and its future in his substantial work. He aimed to provide answers on how to maximize the contribution of AI to E-Learning through the use of tools, technologies, and approaches. He provided an in-depth examination of multiple future evaluations of various key E-Learning variables, as well as a comprehensive overview of the most recent and relevant technology. The book ended with a foreshadowing of how such a model might manifest in the future, based on the multiple interposing circumstances.

Drozдова and Guseva [13] presented a specific report on E-Learning in the banking industry. The article discusses the characteristics and criteria that should be included in a training course, as well as the outcomes of its implementation. They used Donald Kirkpatrick's four-level training efficiency evaluation approach. The author advocated that the relevant indicators are calculated for each level of this model to give a fuller picture of the overall evaluation of the training course. This method includes objective and accurate efficiency evaluations, faster processing of the collected results, and a clear organization of the outcomes and evaluations.

Holmes and Anastopoulou [14] in their research looked at remote education students' perceptions of the benefits and risks of Artificial Intelligence (AI) technologies, which are rapidly being used in distant education. They presented the preliminary findings of a survey of students from the UK's largest distant institution as a first step toward answering the question of what students at distance universities think about AI.

Cruz-Benito et al. [15] attempted to investigate students' opinions of artificial intelligence and education. They wondered if they would be hesitant to be influenced by



nonhuman actors in a human process like education. This work developed a research model based on the Technology Acceptance Model to answer these issues. They presented the model's many primary structures and variables to describe it, and then they analyzed the model's main implications.

Adamu and Awwalu [16] in their paper covered the components of Adaptive E-Learning Systems (AES), the function of AI in AES content aggregation, potential hazards, and accessible opportunities. They also emphasized the need for Intelligent Tutoring Systems (ITS).

Krendzelak [17] in their research looked into machine learning and how it may be applied in E-Learning frameworks. They attempted to investigate the fact that students must devote a significant amount of time to adjusting their profiles to meet the training's learning objectives.

Finally, Demertzi and Demertzis [18] proposed the Adaptive Educational eLearning System (AEELS), which can acquire and analyze data from learning repositories and modify it to the educational curriculum based on the student's skills and experience. It is a new hybrid machine learning system that combines a Semisupervised Classification method for ontology matching with a Recommendation Mechanism that employs a hybrid method trying to combine neighborhood-based collaborative and content-based filtering techniques to provide each student with a personalized educational environment.

### 3. THE Proposed AI-VR Interactive Model

Augmented reality is realized with various devices such as helmets and glasses with more common mobile devices, such as mobile phones and tablets. The built-in cameras of these devices are used to connect the real with the virtual world, giving the user the feeling that he is navigating the real world which has been enhanced with additional objects/information and/or functions as virtual objects are superimposed on the real ones. We note that several augmented reality applications can remove some of the real-world objects. An augmented reality application displays virtual world objects when it recognizes a predefined pattern within the image captured by the device's camera. These patterns are divided into marker-less patterns in which the application displays the virtual world when the camera displays specific parts of the real world and patterns using markers such as a QR (Quick Response) Code. These codes are usually small square images, resembling barcodes and which may include digital information that can be revealed when scanned by appropriate software that accompanies each mobile device, the QR readers.

Specifically, a simple architecture of a network consisting of 2 tropical perceptrons is proposed: the first of which is based on (max; +) and the second on (min; +) algebra, while the total output (maxout) is the sum of the 2 responses. The architecture of this network is summarized in Figure 1.

As shown in the figure above, given an input pattern  $x \in \mathbb{R}^n$ , this network calculates 2 responses, the first of which is a dilation and the second an erosion, respectively:

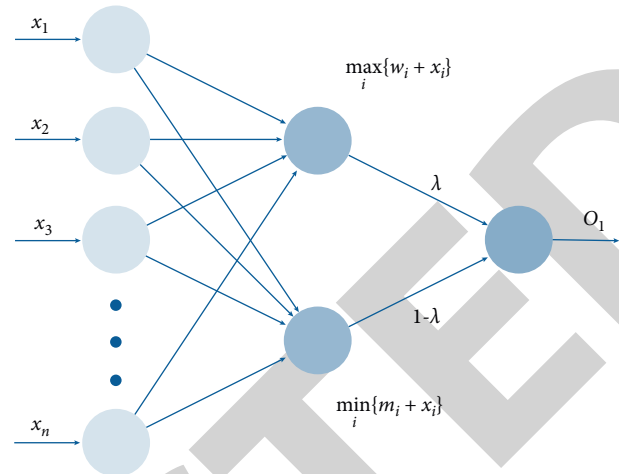


FIGURE 1: Proposed architecture.

$$\begin{aligned} \delta(x) &= \bigvee_{i=1}^n w_i + x_i, \\ \epsilon(x) &= \bigwedge_{i=1}^n m_i + x_i, \end{aligned} \quad (1)$$

choosing  $a = 1$  and  $b = 1$  and vectors  $w = Bs$ ;  $m = B$ , we end up with the morphological gradient, which is used as an edge detection operator and is defined as

$$\nabla^B I(x) = (I \oplus B) - (I \ominus B). \quad (2)$$

So basically, we have a neural network which at its output calculates the sum of 2 partially continuous convex functions of the form

$$h_i(x) = \max_{j \in \{1, 2, \dots, k\}} \{W_{ij}x + b_{ij}\} = \bigvee_k^{j=1} \left[ \left( \sum_{m=1}^n W_{ijm}x_m \right) + b_{ij} \right]. \quad (3)$$

For the optimal solution of the resulting polynomial systems, the polytope continuation method is used to divide the original system into simpler problems and to solve them optimally. Specifically, the Newton polynomial is used for max-polynomials arising from the stereoscopic problem of augmented reality used, to indirectly indicate the number of linear regions, to optimize the problem.

A graphical representation of the proposed technique is presented in Figure 2 above, where we illustrate the idea of creating a thinner system by creating polyhedral homeopathy that reduces a polyhedral to a linear system. The lower hull of the polytone Newton causes triangulation, which is used to count the roots while creating homeopathy with as many paths to follow as the volume of the cell, as shown in the following equations:

$$\begin{aligned} P(x_1, x_2) &= \begin{cases} x_1x_2 + c_{11}x_1 + c_{12}x_2 + c_{13} = 0, \\ x_1x_2 + c_{21}x_1 + c_{22}x_2 + c_{23} = 0, \end{cases} \\ \hat{P}(x_1, x_2, t) &= \begin{cases} x_1x_2t^1 + c_{11}x_1t^0 + c_{12}x_2t^0 + c_{13}t^0 = 0, \\ x_1x_2t^1 + c_{21}x_1t^0 + c_{22}x_2t^0 + c_{23}t^0 = 0. \end{cases} \end{aligned} \quad (4)$$

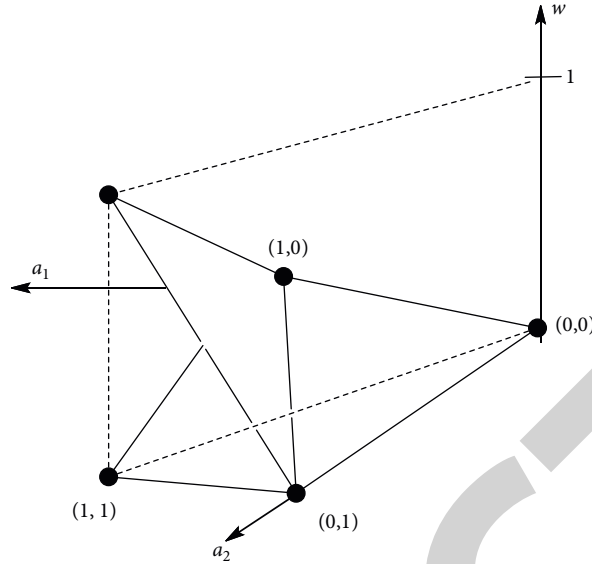


FIGURE 2: Polyhedral homeopathy proposed technique.

Finally, the calculation follows the extension for the determinant, as it corresponds to the sum of the roots by solving the corresponding linear system:

$$P^{(0)}(x) = \begin{cases} \prod_{i=1}^4 (x_1 - \alpha_{1i}) \prod_{i=1}^1 (x_2 - \beta_{1i}) = 0, \\ \prod_{i=1}^3 (x_1 - \alpha_{2i}) \prod_{i=1}^2 (x_2 - \beta_{2i}) = 0. \end{cases} \quad (5)$$

Thus, with a relatively simple calculation at the end of the multipath paths, we obtain important structural algebraic information, which is sufficiently utilized by the system. We define this model as follows:

$$g(x) = \lambda \left( \bigvee_{i=1}^{K_{\max}} c_i + \mathbf{W}_i^T \mathbf{x} \right) + (1 - \lambda) \left( \bigwedge_{i=1}^{K_{\min}} d_i + \mathbf{M}_i^T \mathbf{x} \right), \quad (6)$$

$\lambda \in [0, 1]$ .

So, the initial problem becomes now

$$\begin{aligned} \delta(x) &= \bigvee_{i=1}^{K_{\max}} c_i + \mathbf{W}_i^T x, \\ \varepsilon(x) &= \bigwedge_{i=1}^{K_{\min}} d_i + \mathbf{M}_i^T x. \end{aligned} \quad (7)$$

The proposed application is related to the training course of agricultural education and methods of modernization of crops. The application focuses on the evolution of agricultural equipment and in particular the tools used in ancient times for agricultural work. The trainees are connected to a natural space where some natural objects are exhibited. They can read with QR code information about the tools used in the past, as well as about their development history, receiving the relevant information on their device.

Each tool combines multimedia content (photos, videos, etc.) as well as information and comments from the Internet, news, as well as natural exhibition spaces of the wider area, with information on how and when to visit them. Respectively, the implementation of augmented reality systems supports dynamically changing virtual wanderings, offering interactive games, customizable paths during which the learner moves in the virtual space and determines the evolution of the narrative and the projection of the corresponding content. Essentially, with the use of augmented reality, complex images and physical objects are recognized as stimuli to display the selected multimedia content to the user, enhancing his experience. This way learners can use their mobile device, mobile phone, or tablet and get more information about an item.

Based on the virtual reality methodology in question, the learner can choose to play in a virtual escape room based on a story suggested by the application itself based on an AI recommendation system. The virtual escape room is a themed, adventurous game, in which individuals or groups enter a themed virtual era room and are supposedly locked into it. The goal is to escape in a short time, solving a series of puzzles or missions. The time usually varies and ranges from 15 to 60 minutes. Virtual escape rooms can vary and take place in virtual locations depending on the theme.

The creation of the script, which involves learners in a knowledge game, is completed using QR codes, which can accompany the description of an object and can provide the additional information that accompanies the object. Accordingly, the digital augmented reality information that accompanies the object is displayed on the screen of the device when the user focuses with the device on the specific object. This technology includes additional sound, 3D graphics, and short film projection. When the user focuses on a plow exposed to natural space, a digital augmented

reality representation is displayed, with the plow in its traditional form being dragged by oxen.

The history-space-objects relationship takes and evolves with various versions such as the parts of the story to be unlocked as the trainee moves from one tool to the next or the story to guide the trainee to explore the space-time continuum giving a new dimension to the technological development of agricultural education and the methods of modernization of crops.

#### 4. Discussion

According to research and the corresponding case study, individuals learn best when they receive information in their preferred learning style (e.g., auditory, visual, kinetic, and aesthetic). This finding shows that they learn best when they receive information in a style that incorporates visual, auditory, and kinetic stimuli.

The above findings are in full agreement with research that says that learning improves when learners can examine an idea or concept using a multidimensional approach. In this case, synapses and neural circuits develop, and different areas of the brain are activated, depending on the activity and the way the learner performs this activity.

In the context of online learning, the multidimensional approach can be attempted through a variety of teaching and learning approaches. It is important in the design context that the trainer incorporates a range of activities of different strategies. In this way, learners could engage in experiential activities using a variety of technological approaches. In general, a multidimensional approach provides alternative ways for learners to acquire new knowledge, overcome obstacles, and apply this practice in their daily jobs.

In summary, it seems that in the context of online learning, the educator is important to focus on the following: (a) the active participation of learners in the learning process, (b) how he will integrate the evaluation of learners in the educational process, (c) the utilization of tests the trainees undergo, and (d) the multidimensional approach of both his presence and the activities that will be given to the trainees. The teacher has to ensure that the above focal points need to take place in a properly designed educational environment such as the proposed.

#### 5. Conclusions

Modern information and communication technologies in combination with the Internet offer pedagogy, innovative technical solutions for the culmination of the educational experience, and the promotion of the value of distance education. Environments that adopt virtual reality and its technology can provide several possibilities in the way the learner communicates and interacts with the virtual system or with other trainees. Their suitability to facilitate flexible learning as well as their educational applications can be widely used in the field of education as they manage on the one hand to overcome spatial and temporal constraints and on the other hand provide incentives for enjoyable and immediate learning. Given that pedagogy sets the general

framework, the features and capabilities of these technologies can enrich the already known and tested practices used, adding an active factor in shaping the educational experience and highlighting the experiential nature of learning. Respectively, the role of technologies and at the same time the developments that they signal is the main springboard that can lead to new practices, which promote participation in actions, cultivate respect for educational practices, emphasize the need to preserve educational diversity, and shape the experience of distance education with new methods, discovering new unexplored aspects of it.

In conclusion, it should be noted that the upgrading of the educational process of distance education is a high-priority creative process. For this reason, it must include an evolving dialectical relationship concept between the achievements and practices of modern technology and the traditional educational goals.

#### Data Availability

The data used to support and prove the findings of this study are available from corresponding author upon request.

#### Conflicts of Interest

The authors declare that they have no conflicts of interest regarding the publication of this paper.

#### Acknowledgments

This work was supported by Henan Province Department of Education 13th Five-Year Plan of Education Science Major Bidding Topic.

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