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Significance of Virtual Reality in Knowledge Transfer

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Abstract: *The virtual reality is being more and more used in the education, enabling the student to find out, to explore and to build his own knowledge. This paper presents an Educational Software for presence or distance education, for subjects of Formal Language, where the student can manipulate virtually the target that must be explored, analyzed and studied. With a simple interface, with easy comprehension and using, this paper presents educational software where the student manipulates the objects that will be studied in 3D, getting easier the study of concepts andtheories about Automatons, Regular Expressions and Minimization of Automatons interacting directly with the object in 3D. To the design of the automatons, the software uses tolls in 3D, as the Blender and the VRML (Virtual Reality Modeling Language) and to the publishing of a page on the internet it is integrated the Program Language PHP (Hypertext Pre Processor).*

Keywords: Virtual Reality.

I. INTRODUCTION

Virtual Reality or VR allows a user to interact with a computer generated three- dimensional model or virtual environment. Thisenvironment may be realistic, in the sense that it is familiar to us at a macroscopic scale, it may be realistic in the sense that it depicts the physical world as known to science but which is not usually observable, or it may be used to visualize a world that is entirely imaginary. As such, VR is broadly applicable, and has been applied to, many different areas of education including the sciences, archaeology, history andarchitecture. The advantage of VR over conventional methods of description is that the student is given the opportunity to experience subject matter that would be difficult if not impossible to illustrate or describe with conventional methods.

Modern education often requires a student to comprehend complex or abstract concepts or appreciate scenarios and situations that no longer exist. To this end, common mechanisms for teaching abstract concepts are the use of metaphor and analogy, especially within the sciences. By using an analogy we describe an event or abstract concept in terms of commonly observable reality. That is, we relate concepts to experience. Virtual reality isa technology that replaces sensory input derived from the real world with sensory input created by computer simulation. It provides interactivity by responding to movements and the natural behaviors of humans in the real world. In this respect VR may prove to be a powerful resource that can help in teaching by providing an environment that allows the student to experience scenarios.

II. RELATED WORK

At present, foreign virtual reality technology has a wide range of applications, including military teaching, medical teaching, sports training, and other areas of teaching, virtual reality technology for educators to open up a broader vision, providing a more effective form of education. The United States is a more developed country in virtual reality technology,and its virtual reality technology level is higher than the world average technology level. U.S. research in this field focuses on four areas: student perception, student interface, backend software, and hardware.

SL. NO	PAPER TITLE	REMARK
1	VR Action Interactive Teaching AI Education System.	Platform with visual and auditory all-roundautonomy.
2	Research on VR Interactive Teaching under Environment ofBig Data.	Interactive in the Civics course in the big-data environment, and suitable for also secondary school students.
3	Virtual Reality inEducation.	Opportunity to in still understanding which is impossible by conventional methods.

Table 1: VR in education Research Survey

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The development of VR technology has gone through three main periods, when virtual reality technology first appeared, but there was no complete concept of virtual reality. It was Morton, an American, who created a simulator called Sensorial to facilitate his work, which integrated several technologies, mainly 3D stereoscopic vision, hearing, and smell, and it was an extremely advanced multisensory simulation system. Buttussi published a paper about virtual reality technology, suggesting that the computer screen we use can actually serve as a window to the virtual reality world. It was this idea that sparked a surge of research into virtual reality. The following year, researchers at MIT first began researching helmet-based displays.

III. VIRTUAL REALITY

3.1 What is VR?

In a VR simulation a computer simulates and displays an environment through which we all can walk and interact with objects and simulated people (commonly referred to as 'agents' or avatars). A virtual environment is depicted usually as a three-dimensional world and often virtual worlds try to replicate the real world both in appearance and in the way that objects behave (e.g. the simulation of gravity). It should be noted however, that there is no necessity that this virtual space be similar to thereal world. Indeed, one of the virtues of virtual environments is that they can be used to depict entirely unrealistic scenarios. However, for training purposes virtual environments simulatethe environment in which the student will eventually operate and provide a safe environment in which to test scenarios that would be either too difficult or dangerous to perform in real life. There are many types of VR implementationsand below we have listed 4 common setups:

1. Desktop VR (Monoscopic or Stereoscopic)
2. Immersive VR (HMD, CAVE, wide screen)
3. Collaborative Systems
4. Mixed or Augmented Reality

3.1 VR in Education

Implementing new technologies to meet curricular demands and reach instructional outcomes is often a difficult process, requiring a lot of trial and error. Tertiary education frequently benefits from connected well-fundedresearch environments, allowing for systematic testing and implementation of technologies. Onthe other hand, most primary and secondary educational environments simply lack the funding, knowhow, and capacity to pursue this method of data driven adoption, except in the rare cases when hardware manufacturers sponsor research in these domains.

When VR is used in primary to secondary education, publications take on the form of blogs and word of mouth style communication that are often informal and anecdotal, providing little support for their claims. However, this does not lessen the importance of these publications, as these VR educational experiences can provide great insights into the pedagogy driving actual use of VR. The claims and perceived benefits also provide researchers with hypotheses to investigate further in later rigorous testing. Hence, the authors will include a review of both types of VR publications, those written scientifically and those that are aimed at the general public, in an effort to better encapsulatethe true state of VR in education in 2021.

3.3 How VR Changes the Education Industry?

Before getting into the details of how Virtual Reality in education will help improve the learning experience, it is important to understand the need to improve the quality of education. Education builds a base for a thriving society. And the transfer of knowledge has been a topmost priority for humans. The Education industry has always looked for ways to make learning accessible to everyone in a quick and simple manner. Therefore, many learning technologies aim at enabling thisaccess to information and facts around the world to everyone. Before computers, we used books to retain facts. The rise in digital technology enables us to implement better learning with immersive technologies. Hence, VR in education seems to be the obvious evolution in the educational industry. Virtual Reality in education makes knowledge more easily available for people, and overcomes two significant problems:

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1. **Fact Retention:** We can all agree upon the fact that being informed is not the same as being educated. Current education system is based on a rather old format. Learning and teaching methods just focus on providing facts.
2. **Systematic learning:** Students generally face difficulties in understanding information. Sometimes, too much information becomes overwhelming for them. As a result, students get bored and disengaged from the whole learning experience. **"53% survey respondents revealed that they plan to use VR in the near future. About 68% acknowledged that VR technology excites the students to learn."**

Hence the use of VR technology is expected to further engage young learners. Let us now have a look at the characteristics of VR in education.

IV. METHODOLOGY

There are many navigation devices that can be used for VR systems depending on what type of visual input device is used. In the CAVE for example, the user is free to walk around and their position in the virtual space is calculated by a head or body tracker. These trackers are usually electromagnetic devices that detect changes in an electromagnetic field depending on the position of a marker placed on the users' head or limbs.

The sensory interface layer of the system provides input and output to and from the user. It is easily expandable and may include few or many components. Essential components include a visual interface that allows the user to see the world and some form of navigation device. Common visual interfaces include head mounted displays (HMDs) which are used for immersive simulations.

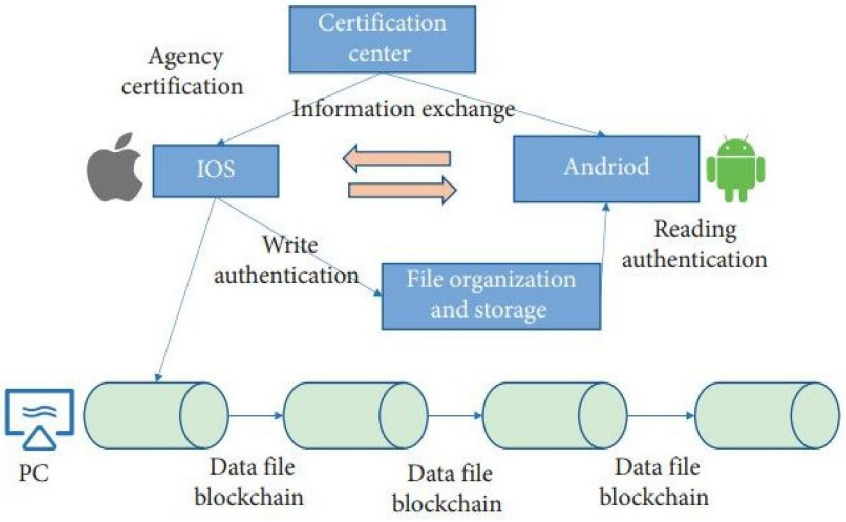

Fig 1: Functional module design

If there is a one-to-one mapping between the real and virtual environments then it is possible for data, text, overlays and even virtual characters to be presented interacting with real objects. The usefulness of this for education and training purposes is far reaching because it combines the realism of real world scenarios with the informative detail of computer visualization. Uses include, for example, training for engineers in the functioning of complex mechanisms such jet engines and in medical applications.

The server will process the events according to the queue order, and after the processing is completed, it will modify the scenario database; moreover, it will pass the modified data to the client and update some of the data. If the event execution fails, then the server sends feedback to the corresponding client and prompts the user. The content of user management mainly includes user information management, user operation record query, query on user operation behavior, and query on operation user.

4.1 Phases of Methodology

After several brainstorming and evaluating sessions with colleagues who had been involved in previous virtual reality projects and analysis of the methodologies described in the references mentioned above, we put all this experience

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together and made a suggestion for a new methodology. After deployment on the first projects (see the Validation chapter), we made some corrections and this methodology was further enhanced.
The methodology is divided into six phases, see fig. 1.

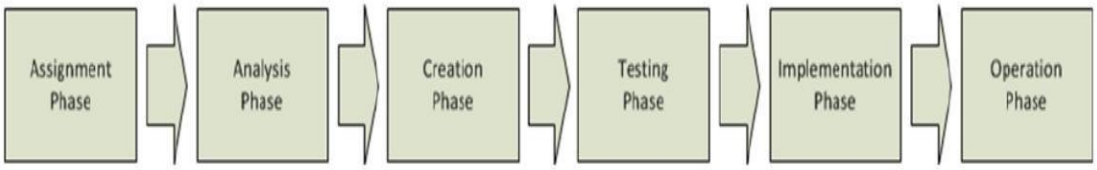

Fig 2: The phases of methodology

A. **Assignment Phase**

In this phase, the customer and the developer work together. This phase should be performed as carefully as possible and everything should be taken into account, as it's the foundation for further work. The customer has to have an idea of the overall concept of the virtual reality application to be able to describe his requirements and wishes, so that the designer can be able to meet them.

B. Analysis Phase

The output of the assignment phase now needs to be analyzed to get the foundation to build the whole application upon. This must be conducted especially carefully, because minor faults in this phase will steer the direction of progress off course.

C. Creation Phase

This phase consists of creating the assets of the virtual environment - the small bricks that build the whole virtual world. The requirements for some assets can be clear from earlier phases of the analyses or even from the scenario draft.

D. Testing Phase

This phase is done thoroughly during the whole project. Everything should be testedas soon as possible. Not only the scripts should be tested, but also all the assets together.

E. Implementation Phase

This phase consists primarily of deploying the software application with the hardware and calibrating it for light and acoustic conditions.

F. Operation Phase

The project is not closed after implementation. The developers should have the opportunity to monitor the implemented virtual environment and to collect data for further debugging or modifications.

4.2 Core Motion Framework

In order to increase the reality factor of the experiment, head movements are captured and transferred to the student applications. We have used Apple's Core Motion Framework to obtain motion data produced by built-in gyroscopes and accelerometers of smart phones. The movement data has been unified at camera Roll Node, camera Pitch Node, andcamera Yaw Node used for camera movements.On the other hand, student applications animate the application of selected sorting algorithm for the given array elements. This visualization is performed based on Stereoscopy technique with binocular vision.
The main objective of this technique is to giveand enhance the illusion depth of vision bycreating a 3D view for the students. Arrayelement moves based on the selected algorithm's working principle as an animation during the VR session. Moving elements are highlighted with different colours to attract student's attention. Screenshot of an experimentis presented. Also, these experiments areempowered with the lecturer's narrative duringthe training session.

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The instructor can see students in the active session from his own application qua the active with blue- and passive with gray-peers as colour coded. This list allows the lecturer to monitor which students use the VRENITE application in the class.

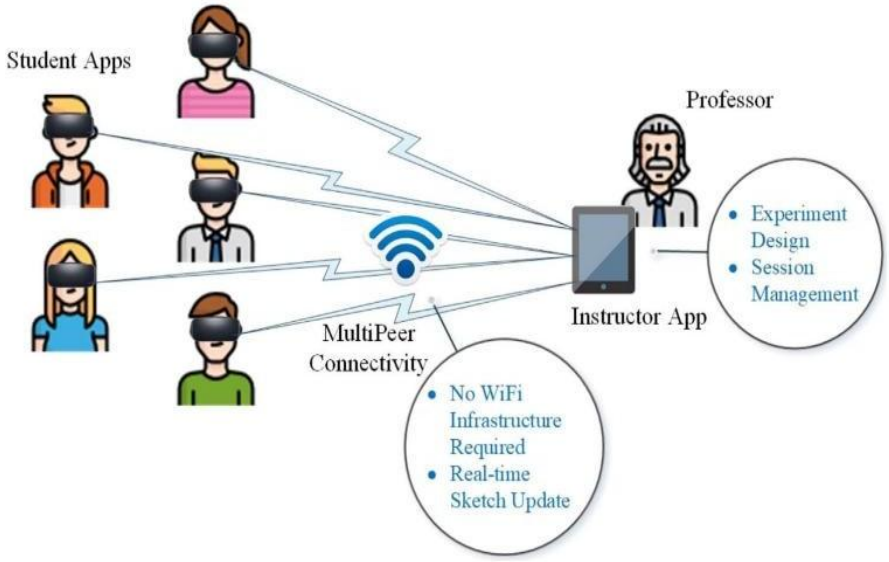

Fig 3: The overview of VR System

The most important feature that differentiates our VRENITE system from its alternatives is that it works on the IOS operating system. We could easily use popular VR glasses such as Oculus Rift and HTC Vive as part of this system, and we could also get benefit from game engines such as Unity3D and Unreal Engine. Since we designed training scenarios which do not require high-level visualization, this decision enabled us to develop the system with native frameworks of IOS.

This advantage helps students with an IOS-based smart phone to do several experiments with only a simple VR glass like Google Cardboard which is less than $10. Head Mounted Displays (HDM) such as Oculus Rift and HTC Vive, which require a computer with an external graphics card, cost around $500. For this, it is considered as a high-cost solution which limits the applicability of these systems. Apart from financial difficulties, a special laboratory must be built to use these expensive devices effectively in an appropriate environment. Our VR-ENITE solution was designed to be not only low cost but also easily accessible anywhere and at any time.

This proposed system consists of two different modules, namely instructor application and student application. Lecturers in VR-ENITE system initiate the learning session through instructor applications. This mobile application has been built for tablet devices in order to configure the experiments to visualize the selected sorting algorithms. Before launching the experiment session, students discover and connect to instructor application via their student applications. These multi-peer connections are established by using Bluetooth technology to form up a decentralized network structure. After the connection is established, the next key task is to maintain the connection between devices. This is generally tough to realize due to energy saving modes of mobile operating systems. Details about multi-peer connectivity are presented in section 3.3. We have implemented heartbeat mechanism to check the active connections in the session. If Wi-Fi is available in the network, all the applications first try to use Wi-Fi instead of Bluetooth.

The immersive virtual reality classroom was built mainly using 3 DS Max software for modelling the basic model and giving the materials, and Pano2VR was used to convert the virtual classroom into panoramic mode. The virtual reality classroom built this time did not achieve real interaction; after all, a completely immersive virtual reality environment requires a technically mature R&D team. Before building a virtual reality classroom, it is important to be clear about what objects are in the classroom, how they are placed, what the size of the specifications is, and what the specific values of the length, width, and height of the classroom are, which is the prep work for conducting a basic scene modelling. By modelling the virtual classroom concerning a real classroom, students can be less distracted and more attentive to their learning when they are in a real teaching situation.

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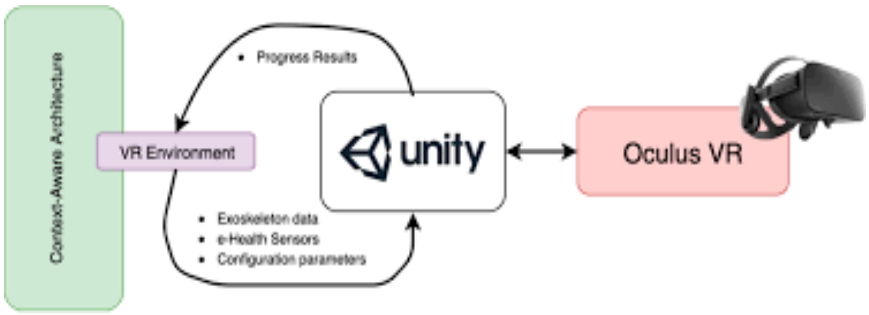

Fig 4: The designing of VR

Students can consolidate their knowledge by checking for gaps based on detailed scores. Teachers can also log into the learning management system to inquire about students' learning and analyze the important and difficult points in teaching through visual data, to improve the teaching process as well as teaching methods in a targeted manner and enhance the quality of teaching.

Students were first asked to view the generated dynamic VR panoramic virtual classroom map through the web version and choose their observation angle in full-screen mode by going up, down, left, right, zoom in, zoom out, and auto rotate to roam around the virtual reality classroom to personally experience and feel the visual impact of the immersive virtual reality classroom. After experiencing the immersive virtual reality classroom, we get the students' emotional feedback by comparing it with the real physical classroom.

V. SYSTEM ARCHITECTURE

After analyzing the functional and technical basis of the platform, the platform is logically divided into three layers of architecture: the interface representation layer, the logical interface layer, and the data storage layer. The interface representation layer is where users interact directly with various web pages and client interface software, the logical interface layer establishes an abstraction for the functions provided by the system to separate services and data, and the data storage layer is responsible for the permanent storage of data from the logical interface layer. The main function of the server computer is to help implement user queries, logins, and other operations. Inside this platform, user scenarios need to be consistent.

In order to meet the consistency of the server scenes, it is necessary to complete the corresponding interaction behavior after the user logs in to the scenes; with the help of such interaction, it is possible to modify the content and properties of the scenes, and it will update the various scenes corresponding to the platform; however, the server and client interaction presentation has a lag, so a client must submit the relevant information to the server. After receiving the user information, the server first makes a simple judgment on the information, such as the attributes of the entity, user rights, and priority and then assigns it to the processing priority queue according to the situation.

The server will process the events according to the queue order, and after the processing is completed, it will modify the scenario database; moreover, it will pass the modified data to the client and update some of the data. If the event execution fails, then the server sends feedback to the corresponding client and prompts the user.

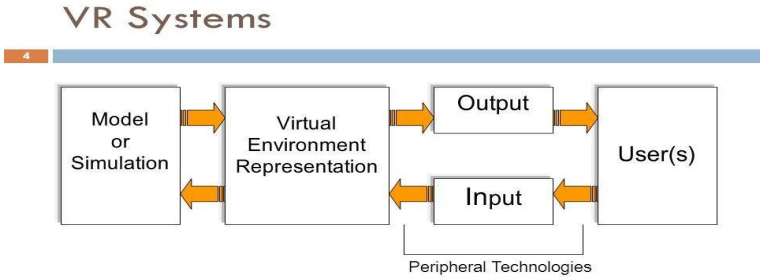

Fig 5: The VR system architecture

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When the system administrator initiates a course information deletion request, the front- end controller receives the course information deletion request initiated by the system administrator, finds the corresponding controller, and then forwards it to the corresponding business logic to process the course information deletion request, and, in the business logic processing, deletes the course information from the database, and returns the course information deletion result information. In the course information addition, synchronous interaction technology is used. After the client publishes the course information, through synchronous interaction technology, other clients can see the course information added by this client after refreshing again.

Teachers can view and reply to students' messages and delete illegal messages, while students can fill in messages and submit messages. When a teacher initiates a request for a message, the front-end controller receives the message request from the teacher, finds the corresponding controller, and forwards it to the corresponding business logic to process the message request, and, in the business logic processing, queries the user's message information from the database, and returns the result information of the message query. In the message addition, the synchronous interaction technology is utilized. After the client publishes the message information, other clients can see the message information added by this client after refreshing again through the synchronous interaction technology. Message information lists will be described by trapezoidal fuzzy numbers. Before introducing trapezoidal fuzzy numbers, we briefly understand the definition and operation of LR-type fuzzy numbers.

VI. DESIGN AND IMPLEMENTATION OF VR

The maturity of virtual reality technology in recent years has injected infinite vitality into the new concept of teaching method proposed by computer assisted teaching, and the humanized interactive teaching method will be developed at a high speed. Therefore, the application of virtual reality technology in education will become a hot topic of education reform, and the concept of "immersive teaching" is born. The platform function is optimized, and then a fuzzy two-layer linear programming model for the product family parameter design can be established as shown in figure.

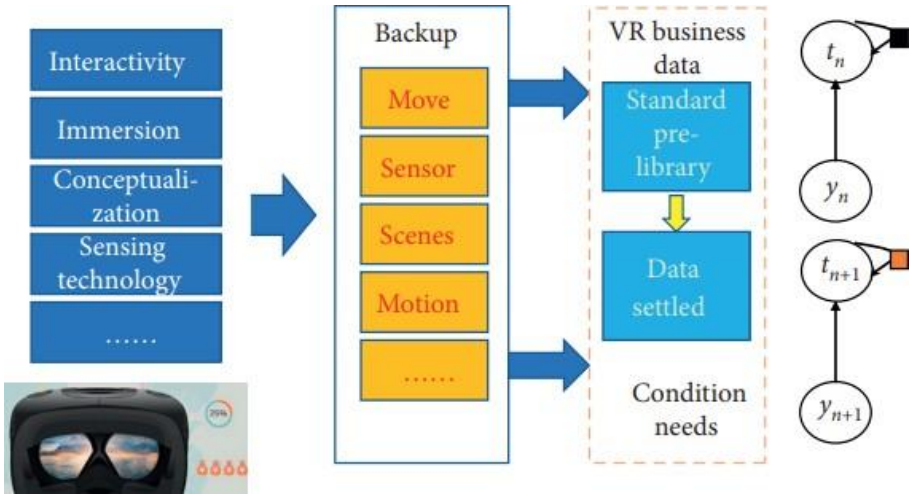

Fig 6: The VR technology scene display

In order to achieve the above functions, the functional modules are designed as shown in fig. 6

1. **Login Statistics Module:** it is used to count the login status of users, mainly based on the concurrency, area, time period, and current number of online users for the current and historical login data. The data file block chain can be obtained in the interactive record, which was easily realized based on the app.
2. **Database Storage Module:** it is used to store account information data, user login statistics, and other data uploaded to the platform when registering on the teacher side or student side, so as to facilitate the subsequent search and verification of data information.
3. **Interface Management Module:** it is used to distinguish the user interface for rendering different roles, to facilitate the display of the corresponding role interface once different role users log in, with the said student-side display interface being different from the teacher-side display interface.
4. **Resource Management Module:** it is used to manage the resources stored in the cloud server in the software

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on the teacher side and the student side, including uploading, downloading, deleting, updating, and finding operations of 3D video resources, 3D model package resources, and audio resources on the teacher side and the student side, so that it is convenient for the teacher and the student to request resources from this module in a timely manner.

5. **Information Relay Processing Module:** it is used for relaying and parsing the received control information sent from the teacher side to the student side and the feedback information sent back from the student side to the teacher side, so that the teacher side and the student side can interact with the data stream. The interface representation layer is where users interact directly with various android pages and client interface software; the logical interface layer establishes an abstraction for the functions.
6. **Data Push Module:** it is used to push relevant data information to the student side or the teacher side according to the request sent by the student side or the teacher side.
7. **Log Management Module:** it is used to record some log information of the system itself to facilitate operation. After analyzing the functional and technical basis of the platform, the platform is logically divided into three layers of architecture: the interface representation layer, the logical interface layer, and the data storage layer.

VII. CONCLUSION

Technology continues to evolve rapidly, changing everyday norms and influencing every facet of human existence. Even simply being aware of the latest technological innovations can be daunting, and applying the technology even more so. The field of education often adapts to change more slowly than other sectors, but always inevitably transforms to embrace or accommodate change. Digital delivery of lessons through video conferencing software once fell into this category, but now has become an educational norm. VR has now begun this transition from a fringe technology to a technology capable of being used in mainstream practice. The 2020 corona virus pandemic has also highlighted just how much global issues can impact educational models. VR Instead, vr has been receiving attention as a tool for distance education and home study.

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