



Integrating Immersive VR and Data Mining for Improving Skills: Design and Evaluation of an Interactive Learning Platform

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ABSTRACT

This work explores the integration of immersive virtual reality (VR) technologies and data mining to enhance talent development in education. It highlights the limitations of traditional teaching models overemphasis on theory, lack of personalization, and disorganized resources and proposes an immersive learning platform built using Unity 3D and 3ds Max, compatible with the Oculus DK2 VR headset. The platform simulates realistic environments (e.g., virtual campuses) to foster deep engagement through interactivity, spatial realism, and intuitive navigation. A key innovation is the incorporation of data mining techniques, particularly artificial neural networks (using the perceptron rule), to process user interaction data, optimize system performance, and tailor learning experiences. Results show significant improvements post implementation: response time decreased from 2.3s to 0.78s, scene count doubled, and visual detail quality improved. Collision detection and dual mode roaming (automatic/manual) further enhance immersion and usability. The study concludes that combining immersive VR with targeted data mining creates a more effective, personalized, and scalable environment for cultivating innovative, interdisciplinary talents. However, challenges remain in reducing data redundancy and improving system speed. The platform demonstrates strong portability across devices and offers a replicable model for future VR-based educational systems.

Keywords: Talent Cultivation, Immersive Learning, Virtual Reality (VR), Data Mining, Unity 3D, Artificial Neural Networks, Educational Technology

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1. Introduction

The engaging platform has garnered significant interest due to its simulation features. Nevertheless, analogue modelling produces a large amount of data. Consequently, finding ways to enhance user experience while minimizing data has become an important issue to address. Data mining, a prominent technology in recent years, supports decision making by extracting relevant information from complex datasets and by under

standing relationships within them [1]. Immersive learning has been around for quite some time, leveraging characteristics such as non intrusiveness, time distortion, and self forgetting to help students enter a learning state after a specific duration, demonstrating that the approach is indeed practical. It also focuses on how to facilitate students' immersion in learning while minimizing the five key principles that can obstruct individual and collective immersion. However, immersive teaching has not yet been integrated with relevant technologies [2]. The initial immersive platform utilized a virtual reality setting, considering at a more profound level whether the construction was reasonable while simultaneously minimizing material waste to enhance the user's experience [3]. As times have progressed, the integration of new technologies in education to develop competent individuals has become a societal concern. At this juncture, the introduction of an immersive teaching system can ignite students' enthusiasm for learning and promote their independent studies [4].

2. Current Status

In response to learners' needs regarding the system, this paper presents an immersive learning system based on Unity 4.6 and 3ds Max. Section 2 discusses the process of nurturing innovative talents and the current educational landscape in our country. Section 3 elaborates on the technical methods utilized in this study and outlines the essential core technologies. Section 4 showcases some functionalities of the system, its usage, and related enhancements. Lastly, Section 5 evaluates the system's strengths and weaknesses. The cultivation of innovative talents has consistently been a focal point across various sectors. In an era when science and technology were less advanced, teachers often tailored instruction to students' aptitudes. However, teachers are now overwhelmed. Education has undergone rapid transformation in recent years, propelled by advances in Internet technology. Nevertheless, the abundance of diverse teaching resources leaves learners uncertain about where to begin, and the educational materials tend to be disorganized. This poses a significant barrier to the learning of beginners [5]. Simultaneously, the vast amounts of data generated online have yet to be repurposed effectively. Therefore, coupled with the rise of data mining in education, this method becomes more targeted. It utilizes the platform to generate extensive real-time data mining, guiding learning behaviors and contributing to the establishment of an immersive, personalized online learning environment [6]. However, relying on a single learning approach remains inadequate to enhance students' engagement in learning. As researchers increasingly explore virtual reality systems, they tend to prioritize immersive teaching experiences, yet often neglect to provide insights into the learning journey. They are unable to meet the personalization of the user's requirements. Nonetheless, the current immersive system fails to meet educational requirements; there remains significant potential for improvement in accuracy and speed [7].

3. Methods



Figure 1. Modern immersive teaching

As science and technology advance, utilizing new technologies to help learners develop their skills is becoming more prevalent. Educators are increasingly focused on sharing knowledge via the Internet. Learning technologies have expanded across multiple platforms. Recently, emerging virtual reality technology has attracted the attention of researchers conducting teaching experiments, as illustrated in Figure 1, with immersive learning identified as a methodology. By integrating immersive learning with virtual reality, it is possible to replicate real world environments, enabling learners to engage with actual scenarios more directly and vividly. The virtual learning environment facilitates skill enhancement through highly interactive activities and exercises. The immersive system supports both the virtual campus and the virtual city. It gathers relevant information by simulating real life scenes, thus preventing significant errors and the waste of financial and material resources typically encountered in conventional modeling. Initially, immersive platforms are combined [8].

3.1 Data Mining in the Construction of an Innovative Talent Training System

This study aims to merge data mining with immersive systems to construct the system’s design and data processing, utilizing data mining for artificial neural network learning in the initial data processing phase.

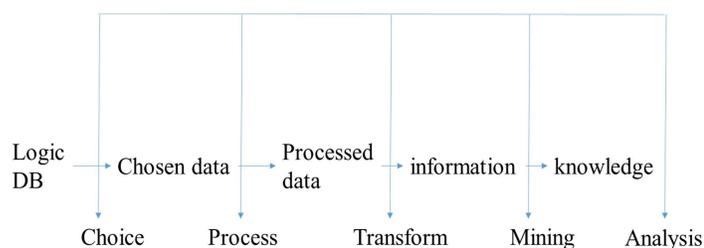


Figure 2. Data mining process

Figure 2 illustrates the process of mining potential information through database logic processing. Two comparable algorithms are involved in artificial network learning: the perceptron training rule and the gradient descent rule. The main difference between these two rules lies in whether the training examples are linearly separable or convergent [9]. Both algorithms guarantee convergence to acceptable outcomes, albeit with slightly different assumptions under varying conditions. In this study, the sensor training rule is employed. The sensor takes in a real-valued vector, computes a linear combination of these inputs, and subsequently outputs ‘1’ if the result exceeds a certain threshold or ‘-1’ otherwise. More specifically, if the inputs are x_1 through x_n , the output calculated by the perceptron is:

$$o(x_1, x_2, \dots, x_n) = \begin{cases} 1, w_0 + w_1x_1 + w_2x_2 + \dots + w_nx_n > 0 \\ -1, otherwise \end{cases} \quad (1)$$

Each w_i in Equation (1) is a real constant, or weight, that determines the contribution of input x_i to the perceptron output. Note that the constant $(-w_0)$ is a threshold set such that the sensor outputs 1 if the weighted sum of the inputs exceeds it.

To simplify the representation, suppose there is an additional constant input $x_0 = 1$. Then, we can write the above inequality as $\sum_{i=0}^n w_i x_i > Q$ or as a vector written as $\mathbf{w} \cdot \mathbf{x} > 0$. For the sake of brevity, we sometimes write the sensor function as:

$$o(\mathbf{x}) = \text{sgn}(\mathbf{w} \cdot \mathbf{x}) \quad (2)$$

In Equation (3),

$$\text{sgn}(y) = \begin{cases} 1, & y > 0 \\ -1, & \text{otherwise} \end{cases} \quad (3)$$

Learning a sensor means the value of the options w_0, \dots, w_n . Therefore, the hypothetical candidate space H to be considered by the perceptron learning is a set of all possible real valued weight vectors.

$$H = \left\{ \begin{matrix} \mathbf{r} \\ \mathbf{w} \end{matrix} \middle| \mathbf{w} \in \xi^{n+1} \right\} \quad (4)$$

To explain equation (5) better, the implication is that one way to get an acceptable weight vector is to start with random weights and then iteratively apply the perceptron to each training sample as long as it misclassifies the sample and modifies the perceptron's weight. Repeat this process until the perceptron correctly classifies all training examples. Each step according to the perception of training rules to alter the weight, that is, according to the following rules to modify the input x_i and the corresponding weight w_i :

$$w_i < -w_i + D_{w_i} \quad (5)$$

In Equation (6),

$$D_{w_i} = h(t - o)x_i \quad (6)$$

Where t is the target output of the current training example, o is the output of the perceptron, and h is a positive constant called the learning rate. The effect of the learning rate is to ease the degree of adjustment at each step. It is typically set to a small value (e.g., 0.1) and sometimes decreases as the number of right adjustments increases.

To get an intuitive feeling, consider some special cases. It is assumed that the perceptron has correctly classified the training samples. At this time, $(t - o)$ is 0, which makes D_{w_i} equal to 0, so no weight is modified. If, on the other hand, the sensor output is -1 when the target output is +1, the sensor output must be modified to +1. If $x_i > 0$ in this case, an increase w_i will let perceptron be closer to the correct classification of this example. In this case, training law will increase, because $(t - o)$, and x_i are both positive. For example, if $w_i = 0.8$, $h = 0.1$, $t = 1$, and $o = -1$ then the weight update is $\Delta w_i = 0.1(1 - (-1))0.8 = 0.16$. On the other hand, if $t = -1$ and $o = 1$, the weights associated with positive x_i are reduced rather than increased.

3.2 Immersive Experimental Platform Scene Modeling

Modelling plays a crucial role in the development of the immersive system. The effectiveness of an immersive talent training system is closely tied to scene modeling. In this paper, all scenarios are created using 3D MAX modeling software. Each scene is constructed at a scale of 1:5000 and saved in FBX format. Ultimately, the generated FBX file is imported into Unity 3D for scene setup during modeling, considering both the realism of the model and the speed of the system. As a result, a blend of detailed modeling and simplified modeling is utilized to create a virtually realistic working environment. During the construction of the model, it is essential to minimize the number of faces and segments without sacrificing realism. Invisible faces at the model's intersections must be removed. The maximum number of faces in a single model does not exceed 1: 1000. Otherwise, system operation, through optimising the model in the scene, is to achieve the ultimate effect.

3.3 Immersive Experimental Platform Interactive Interface

An engaging virtual system in interface design prioritizes clarity, intuitiveness, and user friendliness as its core objectives. Key considerations include color schemes, font compatibility, and overall page layout, among other elements. To enhance the experience for users exploring various scenarios, this article emphasizes interface design principles that allocate ample screen space, fostering a greater sense of openness within the educational environment. Consequently, the left button facilitates system interaction, while the expansive area on the right is reserved for displaying the browsing interface and interaction effects during scene navigation [10].

4. Result Analysis and Discussion

The swift transformation of China’s economic framework and the growing global integration of the market economy have led to the emergence of innovative talent. Talent development must transition from a “single-discipline” academic training model to a “broad-spectrum” applied and interdisciplinary training approach; thus, curriculum design and personnel development must fundamentally shift from the traditional language-centered teaching model to one rooted in immersive learning principles [11].

An immersive experimental platform designed to foster innovative talent will generate substantial data, and the key to personnel development lies in the analysis of correlations and intelligent extraction of this vast dataset. By building and utilizing a system’s immersive interactive analysis environment, complex talent data and data mining outcomes are visually and intuitively presented to users, enabling them to grasp the information within the data and interact with it. This integration of human intelligence and machine intelligence is an effective strategy for addressing personnel training challenges [12].

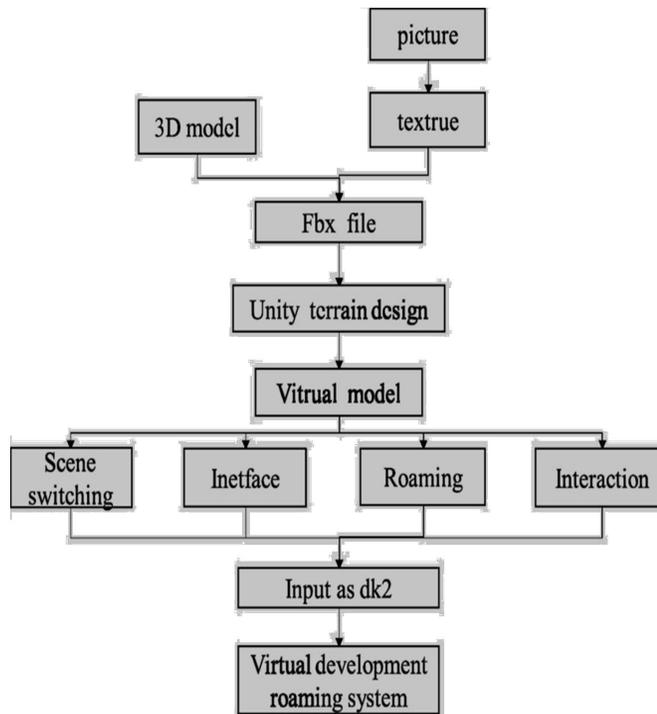


Figure 3. Immersive system setup process

In this paper, data mining is employed to differentiate between detailed and simplistic scenes. To enhance user experience, collision detection has been incorporated. As users navigate the environment, the observer's perspective continuously shifts in response to input device motion. Collision processing is necessary for elements such as trees, buildings, and streetlights; failure to perform it may cause the viewpoint to pass through objects, resulting in a disorienting experience. The system's collision detection function is designed to utilize a triggering mechanism, which identifies an active trigger that includes objects for collision detection, thereby transforming the interaction between the character and the object into a role collision detection with the trigger. This approach mitigates abrupt and unrealistic sensations during collisions, while enhancing system performance and realism [13]. Adjustments to the viewpoint can significantly alter the visual experience for users. Disorienting effects may cause some users to feel dizzy, adversely affecting their overall experience. Additionally, improving the sensitivity of collision detection between the character and the trigger can enhance the system's responsiveness, further enriching the user experience [14].

To ensure that the experimenter fully immerses in the authentic training environment, this article introduces enhancements in the virtual exploration experience, employing a blend of automatic and manual roaming options. When the experimenter is not familiar with the relevant work environment during auto roaming, those who wish to advance the rover's trajectory can engage in autonomous roaming, thereby improving visibility and flexibility. By using the WASD keys for navigation and utilizing a mouse or headset, users can switch their perspective while roaming.



Figure 4. Oculus dk2 dual view

The pivotal aspect of this system is in its presentation. Utilizing the *Oculus DK2*, a virtual reality device released in July 2014, as depicted in Figure 4, it features dual eyepieces, each with a resolution of 640×800 . When in use, the overlapping eyepieces create a three dimensional immersive experience, achieving an overall resolution of 1280×800 , significantly enhancing the user's sense of immersion in the campus environment. Thanks to Unity's seamless integration with Oculus, which provides the same functionality to Oculus users as to Unity Pro users, it is feasible to develop an engaging virtual tour system using Unity 4.6 with Oculus Rift integration. Wearing a virtual reality headset yields realistic testing outcomes, as illustrated.

Given that scenario simulation requires substantial data and computational resources, this article integrates data mining techniques with the previously mentioned methods. As discussed earlier, the user experience of the system before and after data mining is examined using artificial neural networks.

Contrast	Not using neural network	Use neural networks
reaction speed	2.3s	0.78s
Fine detail quality	Rough	More delicate
The number of scenes	5	10

As indicated in Table 1, the immersive system powered by a neural network has shown significant improvements across all metrics. Regarding response speed, data analysis can substantially reduce redundant data and alleviate computational load, thereby freeing additional memory for creating other scenarios through data mining. This approach assesses user sensitivity to real objects. It enhances the distinction between simple and detailed data, rather than relying solely on subjective intuition, thereby improving the system's overall usability and making it accessible to a broader audience. With the inclusion of various scenes, users are also afforded more choices. The greater the variety of contact scenarios, the more effectively trained users can engage their creativity to enhance their innovative efforts.

As highlighted earlier, the development and execution of the immersive system occur entirely within the Windows operating system. The hardware specifications include an Intel(R) Core i5-3230M CPU running at 2.6 GHz, 4GB of RAM, and an AMD Radeon HD 7500 M graphics card, with operational results detailed. The system can be deployed on PCs, web platforms, and other environments, operating smoothly to deliver superior performance outcomes. This confirms the system's excellent portability and its capability to operate across diverse hardware and software setups.

The curricula of domestic colleges and universities place heavy emphasis on theoretical knowledge, often neglecting the integration of knowledge acquisition and the construction of theoretical systems. This oversight results in a deficiency in the development of speculative abilities and systematic training, thereby creating a fundamental weakness. Therefore, fostering innovative talent in data mining requires careful consideration and enhancement. It is essential to thoroughly understand and deepen exploration of core courses in specific majors, the interconnections among subjects, and the themes of knowledge, while establishing comprehensive immersion within a structured professional knowledge framework. Consequently, in addition to creating relevant scenarios, the system enables users from various industries to link to specialized learning platforms and utilize the efficiency of data mining to evaluate and prompt within the system.

Experiments indicate that the system successfully addresses the challenge of limited immersion in virtual exploration. Users can engage with a virtual environment that closely resembles a real campus and interact with it. The system is straightforward to implement and possesses other features that suggest promising applications.

5. Conclusion

Utilizing 3DS Max modeling technology and Unity3D virtual reality technology, this research gathers, organizes, and constructs a complete three dimensional simulation model of the scene information encountered

in specified industries, and develops an immersive 3D virtual training experiment platform based on the *Occulus dk2* virtual reality headset. The results demonstrate that the talent development system designed in this manner surpasses traditional two dimensional digital scene displays by presenting various scenarios in an intuitive, vibrant, and realistic manner. Users experience a heightened sense of immersion while wearing the headset, allowing them to intuitively and comprehensively navigate the entire experimental system and perform a series of actions, such as roaming, transmitting, automatic browsing, and human computer interaction, while feeling fully engaged. On this experimental platform, we observed several key points: to enhance immersion and accurately establish the orientation of the simulated data, specific guidelines cue the user. Furthermore, excessive data redundancy can hinder system performance or cause crashes, necessitating concise data summarization. Data mining technology should adopt a more focused approach; it is unnecessary to analyze every type of data, but rather to concentrate on the issues likely to arise in the profession, thereby reducing computational demands. The development of this experimental platform can serve as a reference for other virtual environments, although several shortcomings remain in the setup process. Improving the practical system's speed and enhancing user experience are of utmost importance. It is hoped that this consideration will be prioritized in the future.

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References

- [1] Yuan Di-ping, Jin Xue-sheng, Zhang Xiao-li, Wang Chang-jiang, Jiang Lian-rui, Wang Xing-bo, Shen Jian-yi. (2012). Design And Implementation of Immersive Environment For Firefighting Tactical Training. *Fire Science And Technology*, (2), 162-165.
- [2] Tingting, Li., Shi, Liu., Falu, Chen. (2017). Research on the development and key technologies of immersive virtual campus simulation system. *Microcomputer Its Applications*, 36 (1) 79-82.
- [3] WU Xiaozhu, CHEN Chongcheng, LIU Xianfeng, LI Jieguang, FANG Lina. (2016). Virtual Cultural Tour Guidance System Integrated with IBeacon based Indoor Positioning. *Computer Engineering*, 42 (10), 6-11.
- [4] Wang Jian-tao, Zhao Ji-hai. (2017). Construction of Popular Books Discovery System Based on Data Mining. *Library Theory and Practice*, (4) 94-97.
- [5] SHEN Yi-Ting, ZHOU Ying, CHEN Xia, et al. Prescription characteristics of Chinese medicine for improving learning and memory ability based on data mining. *Chinese Journal of Gerontology*, 2017, 37 (18).
- [6] ZHANG Hao, LEI Hong, GONG Chengbin, PENG Jingdong. (2017). Quantitative Analysis of Virtually Experimental Teaching Using Data Mining. *Laboratory Research and Exploration*, , 36 (9).
- [7] ZHANG Yannxu, HU Chunchao, HUA NG Shu, FENG Shanqiang, LIN Goanqiangz. (2017). Apriori Algorithm Based Data Mining and Analysis Method for Secondary Device Defects. *Automation of Electric Power Systems*, 41 (19).

- [8] Chen Zijian^{1,2}, Zhu Xiaoliang¹. (2017). Research on Prediction Model of Online Learners Academic Achievement Based on Educational Data Mining. *CET China Educational Technology*, (12).
- [9] CHEN Hong-fu. (2013). Immersive Teaching Based on relevant-content Education Model of Undergraduate Business English Majors. *Journal of Sichuan International Studies University*, 29 (4), 158-160.
- [10] LIN Yua. (2017). Research on Data Mining of Valuable Information in Unstructured Network. *Computer Simulation*, 34 (2), 414-417.
- [11] DING Guoyong^{1,2}, CHENG Jinkuan¹. (2017). Experience and Implications of Educational Data Mining in US Universities. *Comparative Education Review*, 39 (5), 73-78.
- [12] PENG Tao, DING Ling-yun. (2015). Performance Prediction Model Based on Data Mining Based Education Students. *Heilongjiang Researches on Higher Education*, (11), 55-58.
- [13] SHU Zhong-mei, QU Qiong-fei. (2014). An Analysis of University Students Learning Outcome Based on Educational Data Mining. *Journal of Northeastern University (Social Science)*, 16 (3), 309-314.
- [14] CUI Xiao, CUI JianTAO. (2017). Research on Project driven Immersion Teaching Model Based on Extreme Programming Theory. *Computer Telecommunication*, (10), 78-80.
- [15] JIANG Ao-shuang. (2017). Thoughts on Chinese Immersion Program in the United States. *Journal of Research on Education for Ethnic Minorities*, (3), 95-100.