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ENHANCING COMPUTER HARDWARE LEARNING AND UNDERSTANDING USING AR/VR.

An Immersive System for Displaying Components on a Big Screen.

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Abstract: This paper explores recent notable breakthroughs in technology like Virtual Reality and Augmented Reality. Numerous real-time and application-based technologies have replaced obsolete ones. According to the research, AR and VR will provide students in the field of education with a wide variety of practical and application-based learning opportunities. Both the definition of these technologies and a brief history of those technologies are provided. The paper then describes the difficulties that education is currently facing and how these technologies might be able to help with some of these issues. The report outlines a few of the similar technologies that are already being used in some capacity along with the fundamental problems and difficulties posed by these technologies are discussed.

***Keywords*: Augmented Reality, Virtual Reality, 3-dimensional**

I. Introduction

Due to the recent rapid growth in technology, which has transformed many aspects of our lives, virtual reality (VR) and augmented reality (AR) have emerged as two of the most innovative technologies. These technologies have the potential to fundamentally alter the way we live, learn, and interact with the environment. While VR immerses viewers in totally simulated situations, AR aims to supplement the real world with digital features. By combining these two technologies, a revolutionary learning paradigm is made possible, allowing students to engage virtually with real-world computer hardware models without being restricted by physical space. Students can examine, modify, and comprehend each component from different angles and perspectives by viewing virtual things on a screen in 3D. This study looks at recent notable advancements in augmented reality, as well as its potential. applications in education. Understanding computer hardware components is essential for encouraging innovation and problem-solving abilities in the constantly changing world of technology. It is becoming more and more crucial to provide students with efficient and immersive tools for understanding complicated concepts as the need for qualified workers in the field of computer science rises. In this perspective, augmented reality (AR) and virtual reality (VR) stand out as innovative technologies that have the potential to completely change how people learn about and understand computer hardware. We can construct virtual objects that come to life in stunning detail by utilizing the power of a wide screen, allowing students to investigate computer hardware in a completely new way.

II. Research Methodology

2.1 A Detailed Description of How the AR/VR System Was Created:

The developed AR/VR system is a cutting-edge educational tool created to offer an immersive comprehension of computer-related hardware components. To project simulated computer hardware components, the system combines Augmented Reality (AR) and simulated Reality (VR) technologies with a wide screen display. This configuration makes group learning in schools, universities, and other educational institutions more feasible and appropriate by doing away with the requirement for individual VR headsets.

Pre-existing technologies are combined to produce a seamless experience for this AR/VR system:

AR technology: The real world environment is overlaid with virtual computer hardware components. Cameras positioned all around the big screen follow the users' positions and motions using computer vision techniques. The virtual components are then accurately aligned with the users' viewpoint using this data, giving the impression that they are physically present in the real environment.
VR Technology: Unlike AR, which overlays virtual things, VR technology creates a fully virtual environment in which users can view computer hardware in three dimensions. The system's potent graphics processing unit (GPU) is used to precisely model and depict the virtual components in real-time.

A sophisticated tracking mechanism is utilized to guarantee the precision and synchronization of the AR and VR components. In order to record users' motions and positions, the tracking system makes use of infrared (IR) sensors and cameras placed thoughtfully around the enormous screen. In order to keep the virtual elements aligned with the users' viewpoints, whether they are using AR or VR, this tracking data is then processed in real-time.

2.2 Hardware and Software Components Used

1. Display on a large screen: TV or high-definition projector: The huge screen allows numerous people to observe and interact at once while providing a clear and detailed image of the virtual computer hardware components.
2. Tracking Mechanism: Users' positions and motions within the system's field of view are recorded by infrared (IR) sensors, which are positioned around the screen. The system uses cameras to recognize the physical surroundings and precisely follow humans.
3. Hardware for computers: To handle data processing and computations for the AR/VR application, a strong central processing unit (CPU) is necessary. Graphics Processing Unit Real-time rendering of the virtual hardware elements and preserving fluid interactions are handled by a powerful GPU. An adequate amount of random-access memory (RAM) is essential for smooth operation, especially when several users are interacting with the virtual components at once.

2.3 Software and Implementation

Create a database structure to hold data about 3D models of computer hardware parts. Create the essential fields, including the model name, details, textures, and any other pertinent information. The backend server should implement API endpoints to accommodate requests from AR/VR applications for retrieving the necessary 3D model data. The 3D model data for the hardware components the AR/VR application needs to display can be requested from the backend server when it is launched. The AR/VR application can render the virtual hardware components with accurate details because the backend server delivers it the pertinent data it needs from the database.

In the backend server, configure a logging mechanism to keep track of user interactions with the virtual hardware elements. The AR/VR application transmits data to the backend server describing the type of interaction and the particular component used when users interact with the virtual components. This interaction data is logged by the backend server and is kept in a database for analysis and progress monitoring. This interaction logging enables personalized learning encounters and offers perceptions into how users interact with the educational material.

Create the backend server with efficient request handling and quick response times in mind to maximize performance. Utilize caching techniques where necessary to reduce unnecessary database queries and accelerate response times. To avoid stopping the server during peak demands, think about using asynchronous processing for time-consuming operations. The backend of the AR/VR system may effectively manage data, handle user interactions, and facilitate collaborative learning experiences while also maintaining top performance by adhering to certain procedures.

2.4 User Interface and Interaction Design

The system's AR interface effortlessly superimposes virtual computer hardware elements onto the users' actual surroundings to give them a sensation of increased presence and realism. Users can precisely pick up, move, spin, and disassemble the virtual hardware components through interactive exploration using hand gestures, all of which are tracked by the system's responsive gesture detection. Overlays and labels provide pertinent information, such as names, functionalities, and specifications, while interacting with certain virtual components, providing a thorough learning experience. Multiple users can gather around a wide screen and engage with the virtual elements together thanks to multi-user capability, which promotes collaborative learning. Guidance is provided by on-screen instructions, helping users make the most of their interactions with the virtual components. The AR system also offers auditory and visual feedback, recognizing users' interactions with immersive cues, boosting the overall impression of responsiveness and immersion in the learning environment.

III. Literature Survey

This study intends to shed light on the revolutionary potential of AR in education to lead us toward a future where students are equipped with interactive and immersive experiences that stimulate innovation and brilliance in the field of computer sciences and information technology. It explores the possibilities of an immersive AR system created specifically for large-screen display of computer hardware components. Accordingly, the development of education systems and learning methods is always a part of research programs, which includes the use of new technologies to take into account educational issues.[3] According to scientists, the main advantages of the introduction of virtual and augmented reality technologies are visibility, realism and practical orientation.[6] There is a development of VR system to train residents for this procedure, as well as an AR system, which can both be used in a training context, as well as during the real procedure by the bed-side.[1] By combination of the technologies of AR (Augmented Reality) and VR (Virtual Reality), it is possible to collect and accumulate the tourist spot information of real space.[4]

The fields of mathematics and engineering have seen the most development and deployment of augmented reality (AR) applications based on markers, according to Mustafa & Didem Alsancak's systematized research on this topic (2020). They also discuss the issues that come with the integration of AR technologies into education in their research. They believe that teacher opposition and technical concerns are the key problems [1].

According to several research, it is more successful to offer students some assistance when they utilize augmented reality (AR) for learning than it is to use regular AR learning. The usage of an adequate teaching framework is required while employing AR teaching, according to some academics. Because developers frequently design the existing AR, it is challenging to fully meet the instructional needs of teachers. Students' motivation to learn will probably decline as a result, and learning confusion will probably rise [8].

The use of AR to interact with virtual objects has been shown in several studies to significantly lessen cognitive burden. For instance, researchers created a reading program for science classes based on augmented reality (AR) that greatly increased the academic performance and learning motivation of primary school kids while also reducing their cognitive load [2].

The outcomes of this survey revealed a prevailing sense of optimism among the majority of participating students regarding the potential of AR and VR technologies in the context of education. Nevertheless, a notable portion of respondents displayed certain misconceptions, particularly pertaining to the perceived health ramifications associated with AR and VR. This phenomenon can be attributed to a limited familiarity among students with these emerging technologies, along with a lack of understanding of their integration within the classroom setting. This study underscores the necessity for comprehensive education directed at future educators, acquainting them with novel technologies like AR and VR while mitigating any apprehension or hesitation. Such technologies have the potential to serve as formidable instruments within the pedagogical landscape. As a corollary of this investigation, future research endeavors will aim to ascertain the determinants that exert influence over positive attitudes towards AR and VR. The insights garnered from this exploration can subsequently be leveraged to enhance motivation among aspiring ICT educators, thereby fostering a more widespread adoption of these innovative tools within the realm of education [10].

IV. Discussion and Results

In conclusion, our research on "Enhancing Computer Hardware Learning and Understanding: An Immersive AR/VR System for Displaying Components on a Big Screen" has revealed the transformative potential of contemporary teaching methods using Augmented Reality (AR)/ Virtual Reality (VR). By combining these cutting-edge technologies and utilizing a single shared big screen, we have created an efficient and cost-effective solution that accelerates students' comprehension of computer hardware components in a more practical and immersive manner.

The utilization of a shared big screen represents a paradigm shift in the field of education, emphasizing equalized learning for all students. By eliminating the need for individual devices, our system promotes collaborative learning experiences in schools, universities, and other educational institutions. This approach benefits both teachers and students, as the life-sized virtual elements on the big screen enhance students' understanding and allow educators to explain concepts in greater detail.

Moreover, the advantages of our innovative approach extend beyond the realm of academia. The application of this technology has far-reaching implications in various fields, including research and development, commercial sectors, and beyond. As the use of AR/VR becomes more prevalent in education and other industries, we anticipate a significant transformation in how knowledge is delivered and experienced. The immersive AR/VR system offers a powerful tool for engaging students, enhancing their comprehension of complex subjects, and fostering a love for learning through interactive experiences. The combination of AR and VR technologies on a big screen presents an inclusive and accessible platform for education, paving the way for a future where advanced technologies are harnessed to revolutionize learning experiences.

Our research underscores the importance of adopting contemporary teaching methods and leveraging technological innovations to create a more dynamic and effective learning environment. The use of Augmented Reality (AR) and Virtual Reality (VR) on a shared big screen holds immense potential for transforming education and making it more immersive, engaging, and beneficial for all stakeholders involved. The implications of our findings extend beyond education, promising to shape the future of various industries and contribute to a more informed and empowered society.

V. Conclusion

According to our research on “Enhancing Computer Hardware Learning and Understanding: An Immersive AR/VR System for Displaying Components on a big Screen”, we have came to the conclusion that the contemporary approach to teaching computer hardware and its components using Augmented Reality (AR)/ Virtual Reality (VR) will hasten students' understanding of the components more thoroughly and practically, and the installation of a "Single big screen" rather than giving each student their own device/gadget will emphasize more on equalized learning as the common means of learning will allow each student to learn in a synchronized pace.

The installation of a shared big screen will be advantageous for everyone, including teachers, institutions, and students, as it will eventually mitigate the drawbacks of separate devices. The elements on the screen will seem more life-sized, which will be more commanding for the students' comprehension and the teachers' ability to explain things in greater detail.

This innovation of using a large screen to display has broad applications and is extremely significant not only in the realm of academia or education but also in various fields of research and development, commercial sectors, etc.

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