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Augmented Reality –Powered Learning: A New Approach for Simple Pendulum Mechanics

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Abstract

AR allows students to grasp difficult concepts more easily. This visual and interactive approach not only aids in understanding but also in retaining information longer, as students can see and manipulate the elements they are studying. Augmented Reality (AR) overlays digital data onto the user's physical surroundings. VR creates a virtual environment for the user, while AR integrates digital data into the real environment. Interactive activities and visuals help students grasp concepts more effectively than just reading textbooks. The idea of a simple pendulum is taught to students through the use of augmented reality. In the proposed system the simple pendulum experiment will be explored via augmented reality technology. The simple pendulum concept becomes more accessible to students due to their engagement with it through AR technology.AR-based simple pendulum implemented and it is observed that students understand it better with the help of AR.

Keyword: Augmented Reality, AR, physics, simple pendulum

Introduction:

AR significantly increases student engagement. The interactive nature of AR applications captures students' attention and maintains their interest in the subject matter. As a result, students are more likely to participate actively in their learning process, leading to better academic performance. AR also addresses the issue of accessibility, particularly for students in remote or resource-limited areas. Learning experience enhanced for learning physics students through the use of Augmented Reality (AR) technology.

Mobile devices such as laptops, personal digital assistants, and mobile phones have become a learning tool with great potential in both classrooms and outdoor learning. AR includes more data to existing situations and makes modern manufactured environments.AR utilized in different areas like gaming, medical and education. Textbooks and other educational reading materials may have built-in “tags” or triggers that generate additional information when scanned with an AR device. Augmented reality's applications extend from helping make decisions to providing entertainment. The experience of augmented reality can be had through various means, including smartphones, glasses, and headsets. [14] proposed an AR application called “Starry Sky Exploration—Eight Planets in the Solar System” which was addressed to secondary schools in China for the Geography curriculum. A blend of digital and physical environments can make studying more entertaining for students. The experience makes it easier for students to retain and recall information because it holds their attention. This advantage overcomes the obstacles in education that arise from unique learning needs, including students inattentiveness, lack of self-assurance, and insufficient foundational knowledge [11]. In an AR application, the real world is transformed with digital images or text [2].

AR bridges the gaps in activities with high immersion requirements, previously inaccessible[3]. With the help of this textbook, students are expected to form mental images of situations they may never come across [7]. An AR-based learning system was offered to demonstrate particle physics experiments [5]. Augmented reality (AR) provides huge opportunities for online teaching in science and engineering, as these disciplines place emphasis on practical training and are unsuited to completely non classroom training[1]. The integration of AR technology into the learning environment is essential for its effective utilization [8]. AR technology is being utilized to create an educational application featuring animations, videos, and 3D models [13].

About Augmented Reality:

Augmented reality is a computer graphics technology that combines a real-time environment with a digital environment. In virtual reality, users experience a whole new world, while in augmented reality, digital information appears on top of the real environment. AR experience

get to user with the help of AR device and Unity.

The most important part of augmented reality is the user. This user is responsible for creation of AR models.AR devices are mobile, computer. Virtual content is a 3D model created or generated by an AR system or application. Virtual content is a type of information that can be integrated into a real user environment. This virtual content can be 3D models, texture, text, images, etc. Tracking is a type of algorithm that helps determine where a device places or integrates a 3D model in a real environment. AR application does not change the position of a real life entity. It only integrates the digital information with these entities.

AR Environment Management

AR Overlay: Superimposing digital information, such as instructions, data, and interactive elements, onto the physical world seen through the camera.

Interaction Handling: Managing user interactions with the AR elements, such as selecting objects, viewing details, and manipulating virtual objects.

About Simple pendulum experiment

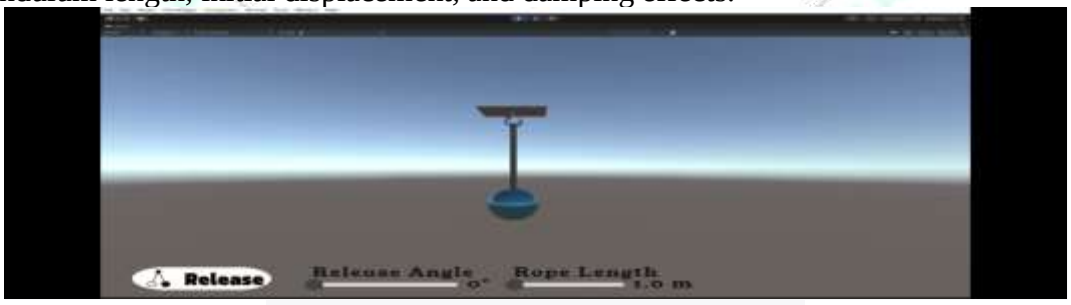
A pendulum is an object that consists of a weight suspended from a pivot, which moves in an arc and complete cycle, consisting of left and right swings, is the duration of the period. A mass 'm' is suspended from a stable base using a thin, elastic string of length 'L'. Gravitational force initiates the motion in the vertical plane. In the case of a simple pendulum, the bob follows Simple Harmonic Motion (SHM), with the acceleration being a function of its displacement from the central position, which is always attracting it.

Development of the AR experiences for the simple pendulum:

A simple pendulum application using AR technology is developed with the help of unity. 3D models are used in pendulum motion experiments. With the assistance of AR, the complexities and difficulties in learning about a simple pendulum are minimized. The use of AR in illustrating the workings of a simple pendulum makes it simpler for students to grasp the underlying concepts. An info page is presented in the application which will help the students to use this App. After starting the app, direct the camera at the ground and let the program recognize the horizontal plane. Once the ground plane has been located, hit the square indicator on the display. Simple pendulum experiments will be augmented on the detected plane. The process for conducting a simple pendulum experiment via Augmented Reality is outlined below, which students can initiate using their mobile devices . After opening the app Augmented simple pendulum appears as shown in figure 1

Step1 - set angle (in degree), Step2 - set Rope length . Step3 - click on Release button

The simple pendulum's motion can be observed by the user in a curved path, going from left to right and vice versa, once the Release button has been clicked as shown in figure 2. Users can then replicate pendulum motion dynamics in the AR application by specifying parameters such as pendulum length, initial displacement, and damping effects.



[Figure 1 -AR based simple pendulum]

The augmented reality game-based learning approach is an advantageous pathway for the development and enhancement of teaching and learning processes. The simple pendulum concept can be grasped by students through the utilization of the lab setup found in the science lab. Students can experience the principles of a simple pendulum through Augmented Reality, making it possible for them to learn from home. These concepts became clearer to students as they engaged with the AR system. The main goal is to enhance the learning experience for

engineering students through the use of Augmented Reality technology. AR allows students to see and interact with a virtual environment

Conclusion:

Augmented Reality creates collaborative virtual spaces where students can work together, share information, and work together to solve problems. Home experimentation for students is now feasible with the assistance of Augmented Reality technology. This innovation offers a substitute for traditional lab setups and facilitates a clearer understanding of theoretical concepts through visualization. The research demonstrated that students who were taught using conceptual change methods for the basics of simple pendulums displayed a superior level of understanding compared to those who were instructed through traditional means. The results were positive because the proposed augmented reality applications offered a high level of usability. This Application is more affordable because it can work offline without an internet connection. This makes it much easier to use in places with limited Wi-Fi or data access. AR has the potential to boost the efficiency of laboratory learning.

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