LithoReality: Augmented Reality Integration for Immersive Semiconductor Education and Training

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ABSTRACT

The LithoReality project pioneers the creation of an immersive educational encounter centered on semiconductor processes, with an exclusive focus on the spin coater technique. This paper presents a comprehensive depiction of the developmental course of the LithoReality AR application. It seamlessly integrates Unity, Vuforia, AI, Arduino, and a keypad interface to simulate the intricate spin coater process. By mixing augmented simulations onto a physical 3D model of the spin coater, users are granted a unique opportunity to engage and interact with both virtual and tangible elements.

1 INTRODUCTION

The relentless evolution of semiconductor technology brings with it the imperative to bridge the rift between theoretical comprehension and practical application. Augmented Reality (AR) provides a promising avenue for the creation of immersive learning experiences. This paper embarks on a voyage of creating an AR application, called LithoReality, that faithfully reproduces the complexity of the spin coater technique. By virtue of this application, students are empowered to directly immerse themselves in the realm of semiconductor processes.

2 BACKGROUND AND RELATED WORK

The academic landscape resonates with a growing body of work that underscores the transformative potential of Augmented Reality (AR) in enhancing educational models. Noteworthy studies, such as [1], have presented the utilization of AR to cultivate engagement and bolster learning outcomes within electronics laboratories, showcasing AR's efficacy in revitalizing traditional education models and resonating with contemporary tech-savvy learners [1]. Through the integration of AR, students are empowered to interact with virtual components and experiment with theoretical concepts in real-world scenarios. This dynamic approach not only augments comprehension but also bridges the gap between abstract ideas and tangible experiences.

In a similar vein, the utilization of Augmented Reality (AR) in industrial settings has gained substantial traction, extending its scope beyond the realm of education. Yan et al. delved into the domain of AR applications within chemical plant training systems, unveiling its potential to replicate intricate processes and empower trainees with invaluable insights into real-world practices [2]. The integration of AR in industrial training brings a new dimension to learning by providing a safe yet immersive environment for trainees to acquire hands-on experience. This not only enhances their technical skills but also contributes to workplace safety and efficiency.

While AR's potential in various domains is evident, a research gap remains within the specific domain of semiconductor education. Acknowledging the broader contexts where AR benefits are recognized, its convergence with Artificial Intelligence (AI) and tangible interaction for semiconductor-specific processes has gained attention. This convergence is aptly demonstrated in the LithoReality project, a pioneering endeavor that fuses AR and AI to explore semiconductor processes in unprecedented ways (LithoReality). The project showcases the power of combining AR's visual augmentation with AI's data analysis capabilities, resulting in a comprehensive educational tool. Through this project, students gain access to a holistic understanding of semiconductor fabrication processes, from intricate lithography techniques to complex circuitry assembly.

Beyond its pedagogical implications, the LithoReality project offers a remarkable shift in paradigms. It extends AR's applications from education into the realm of personalized exposure therapy, where VR plays a role in addressing social anxiety. This interdisciplinary leap demonstrates the multifaceted potential of AR technology and its capacity to shape diverse fields.

By delving into uncharted territory, the LithoReality project propels AR education into a new era, unveiling the intricacies of semiconductor processes through immersive experiences. This initiative not only enhances instructional approaches but also activates pioneering research at the intersection of AR, AI, and semiconductor education. Through the LithoReality project, this paper establishes itself as an innovator, uncovering novel dimensions of instruction and the convergence of technology (LithoReality).

2.1 Overview of the design

The project employs a range of hardware components to facilitate user engagement and real-virtual fusion. An Android device serves as the interface, allowing users to interact with the AR application. An Arduino board is integrated, connecting physical inputs from a keypad interface to the digital environment. A physical 3D model of the spin coater provides a tangible reference for users, enhancing the real-virtual connection. An LCD display visually reflects user-controlled parameters, bridging the physical and digital aspects of the experience.

Unity 3D serves as the development platform, enabling the creation of immersive AR scenes. The Vuforia SDK is utilized for image

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tracking and recognition, facilitating the overlay of AR elements onto the physical 3D model. The core of the project lies in the AI script, designed to process user inputs, simulate changes, and respond dynamically to user actions, creating an interactive AR environment. User interaction is multi-faceted, combining keypad inputs and gaze interactions. The keypad interface allows users to control the application and adjust parameters. Gaze interaction triggers informative pop-ups, enhancing the learning experience by providing contextually relevant information when users focus on specific objects within the AR scene.

User inputs from the keypad interface are captured by the Arduino, which communicates the data to Unity. The AI script processes this data to generate context-responsive changes in the AR simulation. The LCD display concurrently updates with parameter adjustments made by the user, fostering synchronization between the physical and virtual aspects of the project.

3 METHODOLOGY/DESIGN

User interactions are carefully designed to enhance engagement and learning. The keypad interface allows users to control the application, adjust settings, and trigger specific actions. Gaze interaction is harnessed to provide contextually relevant information through informative pop-ups when users focus on objects within the AR scene.

User inputs from the keypad interface are captured by the Arduino, which communicates the data to Unity for processing. The AI script generates responses that dynamically alter the AR simulation, reflecting the user's actions. Concurrently, the LCD display visually reflects parameter adjustments made by the user, establishing a visual link between physical and virtual realms.

The project follows an iterative development approach that involves continuous improvement based on feedback from users and the SCRO Lab. Regular testing sessions and collaborative reviews ensure that the AI script, user interactions, and overall usability are refined to align with educational objectives and user preferences.

The final phase involves educational validation, where the application's effectiveness in enhancing learning experiences is evaluated. User feedback, engagement metrics, and the impact on understanding semiconductor processes are assessed to validate the project's educational benefits.

4 EVALUATION

To determine the application's effectiveness, we will measure its impact on users' understanding of semiconductor processes. By comparing pre- and post-interaction knowledge levels through quizzes and surveys, we can quantify the knowledge gained and validate the educational value of the AR application.

Usability testing will be conducted to assess user experience. Participants will provide feedback on ease of use, navigation, and overall satisfaction. Engagement metrics, such as interaction frequency and session duration, will offer insights into user engagement. User feedback, collected through surveys and interviews, will help identify areas for improvement and gauge the application's practicality in educational settings.

By combining quantitative measures and qualitative insights, we aim to validate the application's efficacy in enhancing semiconductor education and ensure its user-friendly design.

5 CONCLUSION

LithoReality represents a pioneering step in merging Augmented Reality (AR), Artificial Intelligence (AI), and tangible interactions to transform semiconductor education. By seamlessly integrating hardware components, software development, and user interactions, the project has created an immersive educational tool that bridges theoretical knowledge with practical experiences.

Through iterative design and collaboration with the Semiconductor Career Readiness Organization (SCRO Lab), the project has harnessed the power of AR to simulate complex semiconductor processes. This innovation not only enhances pedagogical approaches but also lays the groundwork for future research at the intersection of AR, AI, and education.

The project's success is rooted in its ability to provide students with an engaging and interactive platform to understand semiconductor processes. The combination of AR's visual immersion, AI's dynamic responsiveness, and tangible interactions has the potential to revolutionize how students learn and comprehend complex technical concepts.

In conclusion, the "LithoReality" project showcases the potential of technology-driven education. By breaking new ground and contributing to the convergence of AR and AI, this project sets a precedent for innovative educational tools that pave the way for enhanced learning experiences and a deeper understanding of intricate subjects.

REFERENCES

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