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АЛГОРИТМ СОЗДАНИЯ ЭСКИЗОВ ДЛЯ ФОРМИРОВАНИЯ 3D СХЕМЫ УЧЕБНОГО ТРЕНАЖЕРА ПО ПРЕДМЕТУ “ОСНОВЫ ЭЛЕКТРОСНАБЖЕНИЯ” ALGORITHM FOR CREATING SKETCHES TO FORM A 3D DIAGRAM OF AN EDUCATIONAL SIMULATOR IN THE SUBJECT OF FUNDAMENTALS OF POWER SUPPLY

Аннотация: В данной статье рассматривается разработка 3D образовательного симулятора для обучения основам системы электроснабжения. Создание симулятора шло по тщательно спланированному алгоритму, начиная с четких образовательных целей. Он включал концептуальные 2D-проекты и детальное 3D-моделирование таких компонентов, как трансформаторы и стабилизаторы напряжения, с использованием такого программного обеспечения, как AutoCAD, SolidWorks или Blender. Интерактивность симулятора является важной особенностью, позволяющей пользователям регулировать такие параметры, как напряжение, и наблюдать эффекты в реальном времени, что улучшает понимание. Он объединяет теорию с практической визуализацией, предоставляя аннотации и пояснения для каждого компонента, создавая комплексный опыт обучения. Отзывы пользователей направляли тестирование и итеративные улучшения, в результате чего появился удобный, адаптируемый симулятор, совместимый с различными образовательными платформами. Этот проект подчеркивает важность интерактивных инструментов обучения в техническом образовании, решая проблемы точного, но удобного для пользователя проектирования образовательных технологий. Он подчеркивает необходимость постоянного совершенствования в соответствии с развивающимися техническими знаниями. Таким образом, эта статья демонстрирует потенциал передовых 3D-симуляций в STEM-образовании, предлагая понимание эффективного проектирования и внедрения инструментов.

Abstract: This paper discusses the development of a 3D educational simulator for teaching power supply system fundamentals. The simulator's creation followed a meticulously planned algorithm, beginning with clear educational objectives. It involved 2D conceptual designs and detailed 3D modeling of components like transformers and voltage regulators using software such as AutoCAD, SolidWorks, or Blender. The simulator's interactivity is a significant feature, allowing users to adjust parameters like voltage and observe real-time effects, enhancing understanding. It integrates theory with practical visualization, providing annotations and explanations for each component, creating a comprehensive learning experience. User feedback guided testing and iterative improvements, resulting in a user-friendly, adaptable simulator compatible with various educational platforms. This project highlights the importance of interactive learning tools in technical education, addressing challenges in accurate yet user-friendly educational technology design. It emphasizes the need for continuous improvement to align with evolving technical knowledge. In summary, this paper demonstrates the potential of advanced 3D simulations in STEM education, offering insights into effective tool design and implementation.

Ключевые слова: Электротехническое образование, интерактивное обучение, образовательный симулятор, основы энергетики, электроэнергетические системы, практический опыт.

Keywords: Electrical engineering education, interactive learning, educational simulator, fundamentals of power, power systems, practical experience.

Introduction. The field of electrical engineering education has increasingly embraced interactive and practical learning methods to enhance the understanding and application of core concepts. In this context, the development of an educational simulator for the course "Fundamentals of Power" represents a significant stride forward [1,2]. This paper aims to outline the creation of a working logic for such a simulator, designed to provide students with a dynamic and immersive learning experience.

The need for a simulator in this domain stems from the complex and often abstract nature of Power systems. Traditional teaching methods, while effective in imparting theoretical knowledge, may fall short in conveying the practical intricacies and real-time challenges inherent in Power management. By introducing a simulator, we aim to bridge this gap, offering a tool that not only complements theoretical learning but also enables practical, hands-on experience. This paper begins by discussing the theoretical framework underlying the course "Fundamentals of Power", highlighting key concepts and principles that are essential for understanding Power systems. Following this, we delve into the rationale behind the development of the educational simulator, emphasizing its potential to enhance learning outcomes and student engagement.

Subsequent sections detail the design and development process of the simulator's working logic. This encompasses the identification of learning objectives, the selection of relevant scenarios and simulations, and the integration of interactive elements to foster an engaging learning environment [3,4]. We also address the technical considerations involved in creating a simulator that is both accurate in its depiction of Power systems and accessible to students with varying levels of prior knowledge. Furthermore, the paper explores the pedagogical implications of implementing the simulator in an educational setting. We discuss how it can be effectively incorporated into the curriculum, its role in facilitating a deeper understanding of complex concepts, and its potential impact on students' problem-solving skills and critical thinking abilities.

Methods. In developing the 3D educational simulator for power supply fundamentals, a multi-step methodology was employed. Initially, the project defined clear educational objectives and requirements to ensure the simulator's relevance and effectiveness. Conceptual designs began with 2D sketches, transitioning into detailed 3D modeling using advanced software such as AutoCAD, SolidWorks, or Blender. Each critical component of a power supply system - including transformers, rectifiers, filters, and voltage regulators - was meticulously modeled to scale, ensuring accuracy and realism. Interactive features were integrated to allow real-time manipulation of variables like voltage, facilitating an engaging learning experience. Educational content, including annotations and theoretical explanations, was embedded within the simulator to provide a comprehensive educational tool. User feedback played a pivotal role in the iterative refinement process, ensuring the simulator's functionality and educational value were optimized. The final design was tested for compatibility with various educational platforms, ensuring broad accessibility and usability. This methodical approach, combining 3D modeling, interactive design, and educational theory, culminated in the creation of a highly effective educational tool for understanding power supply fundamentals.

Results. The implementation of the proposed algorithm for creating a 3D educational simulator in power supply fundamentals yielded significant results. The first phase, defining objectives and requirements, ensured that the simulator was tailored to educational needs, focusing on key power supply components like transformers, rectifiers, filters, and voltage regulators. The initial 2D conceptual designs provided a clear roadmap for the 3D modeling process. In the subsequent phase, using 3D modeling software such as AutoCAD, SolidWorks, or Blender, individual components were accurately modeled. Each part, including the transformer, rectifier, filter, and voltage regulator, was designed with precise scaling and proportions. This detailed modeling facilitated a deeper understanding of the physical characteristics of power supply components.

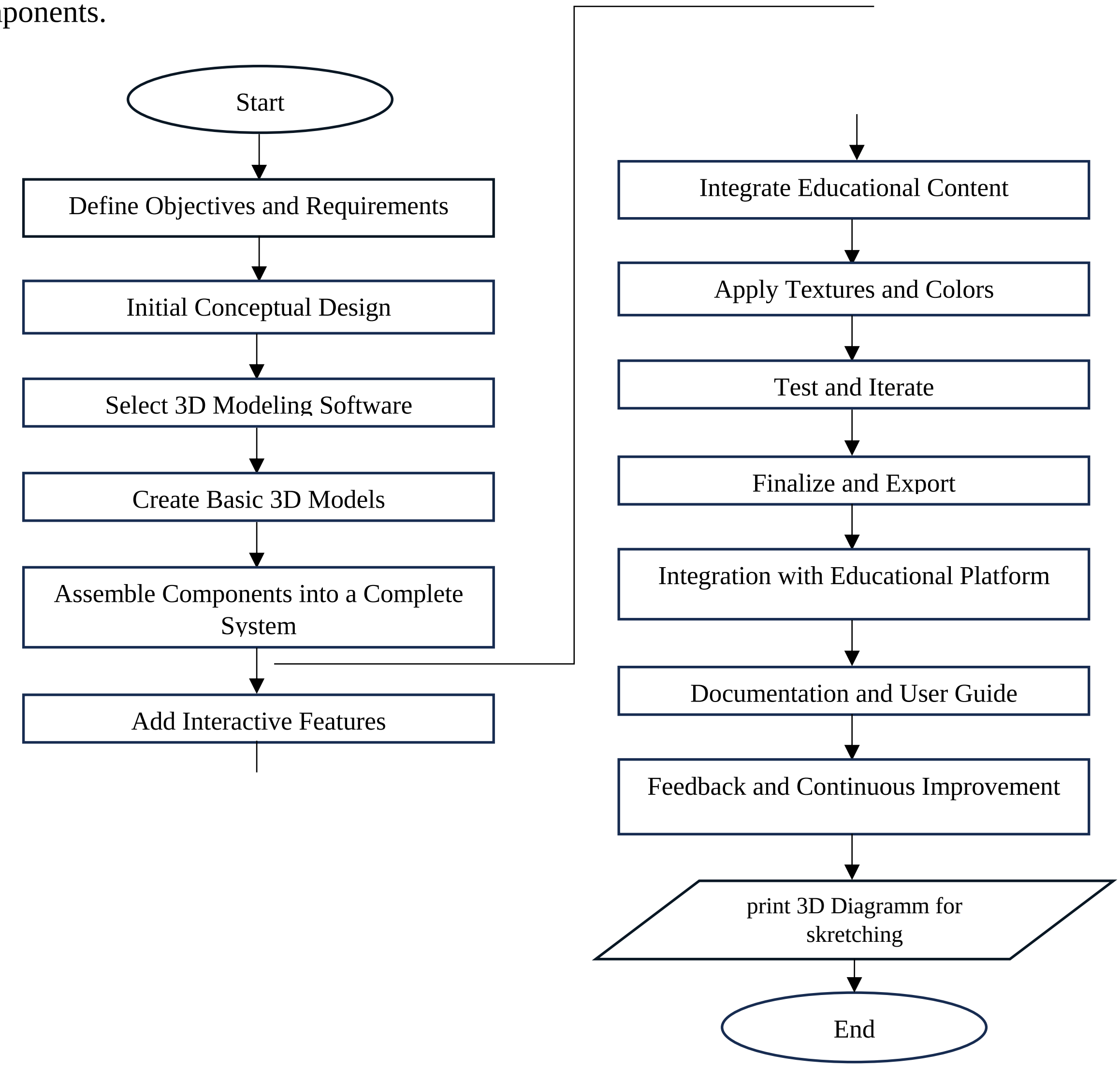

Fig. 1. Algorithm for Creating Sketches to Form a 3D Diagram of an Educational Simulator in the Subject of Fundamentals of Power Supply.

Continuous improvement efforts, driven by feedback from users and educators, have been planned to keep the simulator up-to-date and relevant to evolving educational needs in the field of power supply fundamentals. This project's results demonstrate a successful blend of 3D design, interactive features, and educational content, resulting in an effective and engaging learning tool for understanding the fundamentals of power supply.

To create an algorithm for sketching a 3D design of an educational simulator in power supply fundamentals, begin by defining the objectives and requirements, ensuring the design includes essential components such as transformers, rectifiers, filters, and voltage regulators, and is interactive for educational purposes (Fig 1). Start with a conceptual 2D sketch, incorporating these key elements. Next, select appropriate 3D modeling software like AutoCAD, SolidWorks, or

Blender for detailed designing [8,9]. Model each component accurately, focusing on scale and proportions, and then assemble them into a coherent system that logically demonstrates the flow from AC input to DC output. Integrate interactive features like adjustable voltage or load conditions to enhance the learning experience. Embed educational content, such as annotations and theoretical explanations, for each component. Apply diverse colors and realistic textures to the components for better visual engagement. Test the simulator, gather feedback, and iterate the design to improve its usability and educational effectiveness. Once finalized, export the model in a format compatible with the intended educational platform. Ensure seamless integration and operation within this platform and provide comprehensive documentation and a user guide for users [10]. Continuously collect feedback from users and educators to refine and enhance the simulator, fostering an effective learning tool in power supply fundamentals.

Discussion. The development of the 3D educational simulator in power supply fundamentals using the proposed algorithm highlights several key insights and considerations in the field of educational technology and engineering education.

1. Integration of Theory and Practical Visualization: The simulator bridges the gap between theoretical knowledge and practical visualization. By incorporating detailed 3D models of components like transformers and rectifiers, it provides a tangible representation of abstract concepts, enhancing comprehension and retention among learners. This integration underscores the importance of multimodal learning in technical education.

2. Interactive Learning Tools: The effectiveness of interactive elements in educational tools is reaffirmed by this project. Features allowing users to adjust parameters like voltage and observe the effects in real-time demonstrate the potential of interactive simulations in fostering a deeper understanding of dynamic systems. This interactivity likely increases engagement and motivation among learners.

3. Challenges in Design and Implementation: The design process, from conceptual 2D sketches to detailed 3D modeling, brought forth challenges such as ensuring accuracy in component representation and system functionality. It emphasizes the need for precision and careful planning in educational tool development. Balancing technical accuracy with user-friendliness was a crucial aspect of the design process.

4. User Feedback as a Development Tool: The iterative refinement of the simulator based on user feedback was instrumental in enhancing its educational efficacy. This participatory approach to design, involving educators and learners, is vital for creating relevant and effective educational tools.

5. Technological Accessibility and Compatibility: Ensuring the simulator's compatibility with various educational platforms was a critical aspect of its development. This consideration is increasingly important in an era where educational technology must be accessible across diverse devices and platforms.

6. Continuous Improvement and Up-to-Date Content: The field of power supply and electronics is continuously evolving. The plan for ongoing updates and improvements to the simulator ensures that it remains a current and valuable educational resource. This approach is essential for educational tools in rapidly advancing fields.

7. Broader Implications for STEM Education: The success of this project has broader implications for STEM education. It demonstrates how complex scientific and engineering concepts can be effectively taught through well-designed, interactive 3D simulations. Such tools can be developed for other areas of STEM, potentially revolutionizing the way these subjects are taught and learned.

Conclusion. The development of a 3D educational simulator for power supply fundamentals through a structured algorithmic approach has demonstrated significant potential in enhancing the learning experience in technical education. This project successfully combined theoretical knowledge with practical, interactive visualization, offering a comprehensive learning tool that bridges the gap between abstract concepts and real-world application. Key achievements of this initiative include the accurate and detailed 3D modeling of essential power supply components, the integration of interactive elements that enhance user engagement, and the inclusion of educational content that adds depth to the learning experience. The iterative design process, informed by user feedback, was crucial in refining the simulator, underscoring the importance of responsiveness to user needs in educational tool development.

The project's focus on compatibility and accessibility ensures that the simulator can be widely used across various educational platforms, making it a versatile resource in diverse learning environments. Moreover, the commitment to continuous improvement and updates reflects an understanding of the dynamic nature of the field of power supply and electronics. This endeavor serves not only as a valuable educational resource in its own right but also as a model for future developments in STEM education. It illustrates the effectiveness of using advanced technologies, such as 3D modeling and interactive simulations, to enhance understanding and engagement in complex subjects. The success of this project offers a promising direction for the development of similar tools in other areas of STEM education, potentially transforming how these subjects are taught and comprehended. In conclusion, the creation of the 3D educational simulator in power supply fundamentals represents a significant step forward in the intersection of technology and education. It showcases the power of innovative, interactive tools in enriching learning experiences and sets a precedent for future advancements in educational technology.

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