VenturAR

Revolutionizing STEM Education with AR Innovation

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ABSTRACT

STEM activities are commonly recurring, dangerous, or resource-intensive tasks, which cause challenges both to educators and learners. To make them more engaging and create the feeling of total immersion, Augmented Reality (AR) provides the solution by automating these processes. VenturAR, an AR-based learning app will provide an inquiry based, team-based, and project-based learning techniques, which would motivate collaboration and ignite interest in learners on a low-cost platform that is free and open. By taking advantage of low-cost, VenturAR will create a simulation of real environments and STEM principles that promotes hands-on learning without being exposed to any physical harm or risk and without spending excessive money. Based on well-grounded pedagogical theories such as experiential learning but John Dewey and the Theory of Multiple Intelligences by Howard Gardner, the platform helps bolster engagement, collaboration, and individual learning[1]. Overcoming obstacles like device compatibility, teacher training, and accessibility, VenturAR tries to provide an inclusive solution in the form of a scalable teacher's assisting tool to attract people to high-quality learning in STEM subjects and make it more tempting.

CCS CONCEPTS

• Human-centered computing → Mixed / augmented reality •Software and its engineering → application development •Social and professional topics → Computing education

KEYWORDS

Augmented Reality, STEM Education, Mobile Learning, ARCore, Virtual Lab, Flutter, Android Studio, Blender, Inquiry-Based Learning, Project-Based Learning, Educational Technology.

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1. Introduction

STEM (Science, Technology, Engineering, and Mathematics) education is foundation to training learners who will meet the modern-day workforce requirements. Although Augmented Reality (AR) proves an effective method of learning, increasing the experience of the process, its integration in the school environment remains limited yet, due to its expenses and technical difficulties.To solve these challenges, this paper proposes VenturAR- an AR app that can revolutionize STEM learning among school going kids. VenturAR leverages affordable and pervasive mobile technologies to replicate the laboratory experiments and interactive STEM experiences

This paper outlines the process of development procedure, pedagogical framework, as well as the intended functionality of the VenturAR system and a snapshot of the current prototype phase. Albeit being in development, the early deployment of the application with ARCore, Flutter, Android Studio and Blender shows that it could be an accessible and open-platform STEM learning tool availed in advancement.

2. Challenges and Solutions

The main challenge connected with the integration of AR with STEM learning includes high prices of hardware and software, poor availability of internet, and the technical infrastructure of many schools. AR is also often reported to need more training on the side of teachers to work with, and creating meaningful, curriculum-based AR content can be costly and time-consuming [2]. Moreover, students with underprivileged backgrounds might not have access to compatible devices, further propagating the digital divide and constraining the radius of AR-based instruction[3].

VenturAR provides a ready-to-use, low-cost, mobile-optimized solution based on accessible open-source tools, such as ARCore, and Flutter. The application will be built to work on smart phones freely available on the market, provide tutorials and curriculum-related materials in STEM, and support both educators and learners. Incorporation of pedagogical methods, like inquiry-based learning facilitates an inclusive, engaging learning experience, which supports different people with diverse learning styles, and minimizes the challenges to STEM education, making VenturAR a barrier-free learning experience.

3. Methodology

The production of VenturAR is a user-centered approach to development, iterative, and based upon principles of educational psychology and responsive to real classroom needs. The app is expected to support the involvement of demographic into STEM. AR simulations help students to learn about real-world processes in a prerequisite, virtual environment, which is safer and enhances both kinesthetic and visual modalities. To facilitate the differentiated instruction, VenturAR works with a shared Android device and contains tutorial materials ensuring easy use even by those with limited experience with the platform. This application is coded in Android Studio and with the help of Sceneform provides the immersive augmented reality directly on Android devices. Sceneform makes rendering of realistic 3D assets easy and allows tapping directly into the capabilities with no compromise on performance, across a massive variety of mobile devices[4]. Blender is used to create simulations 3D models and thus allows correct and captivating 3D representation of STEM concepts.

This ensures curricular co-regulation, as well as classroom versatility. End-to-end unit testing has been adopted to check the logic and the UI flow and the database in the app. It utilizes firebase as a main backend platform, which helps in providing real-time database, cloud storage, and user authentication [5]. It has the capability to store user profiles, progress data, and content assets in secure and scale-based storage manner. It is important to note that Firebase has of in-built data encryption protocols and authentication protocols that assist in protecting the user data and as such can be used to comply with the school data privacy requirements. Individual profile pictures and associated visual assets per module are loaded and retrieved through Firebase Cloud Storage, and each user can customize their own visuals and pristinely control content.

3.1 Current Development Progress

VenturAR is at the prototype phase as the most important interface elements and navigation tools are created and are fully operational. The dashboard, as illustrated in Figure 1 is functional and the learners can monitor the progress, choose the types of STEM lesson and remain motivated by the gamified progress meter.

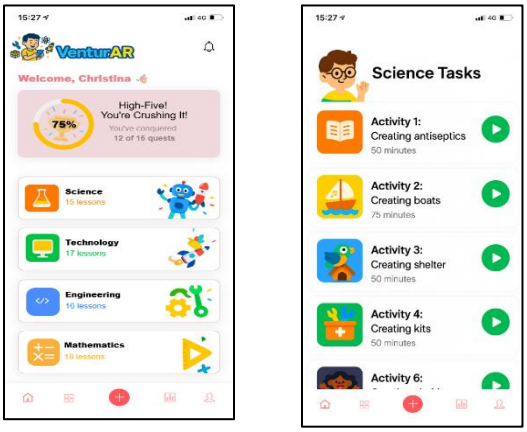

Figure 1. VenturAR Prototype Interfaces

The picture represents this kind of the current prototype of the VenturAR mobile application, which is supposed to be user-friendly and appealing to young learners. It shows monitoring of progress, and easy navigation of subjects with the use of bright icons and images based on student learning. Given that it is meant to be used by younger learners, the user interface is deliberately created in such a way that it only uses big colorful icons and minimal writings. There is a well-illustrated icon and image that portrays each category, and they are all safely stored and accessed through the firebase storage. The work is actively being done on the integration of Sceneform-based AR simulations. These will be in the form of interactive virtual labs, activities to manipulate objects and scenario modeling with real life issues that current learning objectives in the classroom. Successful implementation of Mobile-first user interface/user interface design, in-real time synchronization of databases through Firebase.

4. Future Scope:

Expanding into other STEM areas presents the chance to deliver a more comprehensive and multidisciplinary educational experience, addressing the increasing demand for various scientific, technological, engineering, and mathematics competencies. Ensuring compatibility and support across all devices promotes accessibility, enabling learners to engage with information effortlessly, regardless of whether they are utilizing smartphones, tablets, laptops, or desktops. The incorporation of AI-driven adaptive learning systems customizes educational experience by adjusting content and tempo to align with each student's individual needs, strengths, and advancement [6]. Furthermore, integrating the platform with Learning Management Systems (LMS) enhances accessibility and optimizes course management for educators and institutions. The incorporation of multi-user collaborative spaces promotes teamwork, enhances peer-to-peer learning, and boosts engagement by enabling students to collaborate on projects and problem-solving tasks in real time.

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