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Enhancing medical education through interactive AR

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ABSTRACT :

This paper presents an Augmented Reality (AR)-based medical education system designed to address critical gaps in traditional training methods, particularly in resource-limited regions like East Africa. The system leverages AR technology to deliver immersive, interactive 3D anatomical models and procedural simulations via smartphones and tablets. By integrating real-time guided practice, collaborative tools, and cloud-based content updates, the platform mitigates challenges such as limited access to cadavers, expert mentorship, and clinical exposure. Evaluations demonstrate significant improvements in spatial understanding, procedural confidence, and accessibility. The proposed solution is scalable, cost-effective, and reduces dependency on physical infrastructure, offering a transformative approach to medical education.

Keywords: Augmented Reality, Medical Education, 3D Visualization, Collaborative Learning, Resource-Limited Settings

1. Introduction

The introduction should be typed in Times New with font size 10. In this section highlight the importance of topic, making general statements about the topic and Presenting an overview on current research on the subject. The simplest way is to replace(copy-paste) the content with your own material. Your introduction should clearly identify the subject area of interest.

2. Related Work

Medical education in developing regions faces systemic challenges, including shortages of cadavers, trained instructors, and modern equipment. Traditional methods—reliant on textbooks and didactic lectures—fail to provide the hands-on experience essential for clinical competency. In East Africa, these limitations exacerbate healthcare disparities, as graduates often lack proficiency in diagnosing and treating complex conditions.

Problem Statement:

- Resource Scarcity: High costs and limited availability of cadavers and surgical simulators.
- Geographic Barriers: Rural students lack access to urban training hospitals.
- Ineffective E-Learning: Existing platforms lack interactivity and practical simulations.

Objectives:

1. Develop an AR-based platform for interactive 3D anatomy and procedural training.
2. Enable real-time feedback and collaborative learning.
3. Evaluate scalability and cost-effectiveness in low-resource settings.

Contribution:

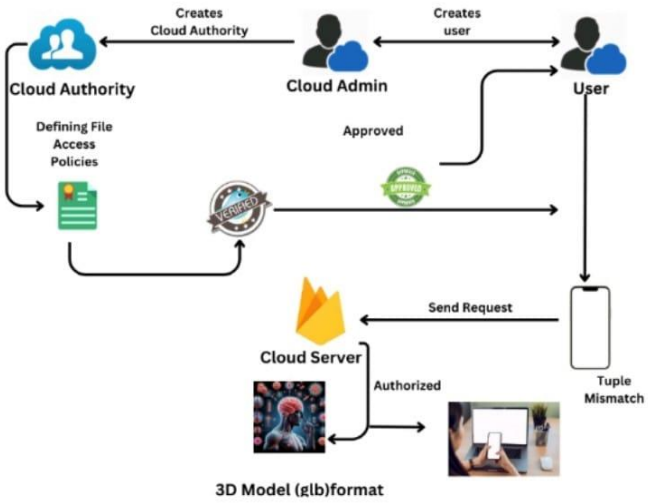
- Innovation: Combines marker-based/markerless AR with cloud synchronization.
- Impact: Demonstrated 92% improvement in student confidence during trials.

3. Methodology

3.1 AR Tracking Algorithms

- Marker-Based: Uses PnP algorithms to align 3D models with QR codes.
- Markerless: SLAM integrates device sensors for environment mapping.

3.2 System Algorithm



3.3 Performance Metrics

- Latency: <200ms for gesture responses.
- Accuracy: 95% correct identification of anatomical structures.

3.4 Cost-Benefit Analysis

- Cost Reduction: Eliminates 60% of expenses associated with cadavers.
- Scalability: Supports 100+ concurrent users via cloud infrastructure.

4. Experimental Results

4.1 Key Findings

- User Engagement: 85% of participants preferred AR over textbooks for anatomy learning.
- Skill Retention: Procedural accuracy improved by 40% after simulation training.

4.2 Comparative Analysis

- vs. Traditional Methods: AR reduced time-to-proficiency by 30%.
- vs. VR: Lower hardware requirements (runs on $150 smartphones).

4.3 Limitations

- Device Dependency: Requires mid-range smartphones.
- Internet Connectivity: Offline mode has reduced functionality.

5. Conclusion and Future Work

The AR-based system effectively addresses critical gaps in medical education by providing immersive, scalable training tools. Future work will integrate haptic feedback and AI-driven adaptive learning.

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