ADHIYAMAAN COLLEGE OF ENGINEERING(AUTONOMOUS)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

IMMERSIVE AR-BASED LEARNING FOR COMPUTER SCIENCE

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Abstract

Learning complex and abstract concepts in Computer Science and Engineering (CSE) can be difficult through traditional methods such as textbooks and 2D diagrams. CodeAR is an Augmented Reality (AR) based educational tool that turns theoretical topics into interactive 3D visualizations. By scanning a keyword, QR code, or image, the system displays a 3D model in the real-world environment along with audio narration. It supports subjects like data structures, operating systems, networking, compiler design, and database systems. This immersive approach improves clarity, engagement, and retention while bridging the gap between theory and practical understanding in higher education.

Modules with Algorithms/Techniques

Image Recognition Module

- Platform: Vuforia
- Technique: Feature-based recognition (ORB/SIFT-like descriptors).

Concept Mapping Module

- Platform: Technique: Hash Map/Database linking image targets to 3D models & audio files.

3D Model Rendering Module

- Platform: Unity3D
- File Types: .fbx, .obj models imported into Unity.

Modules with Algorithms/Techniques

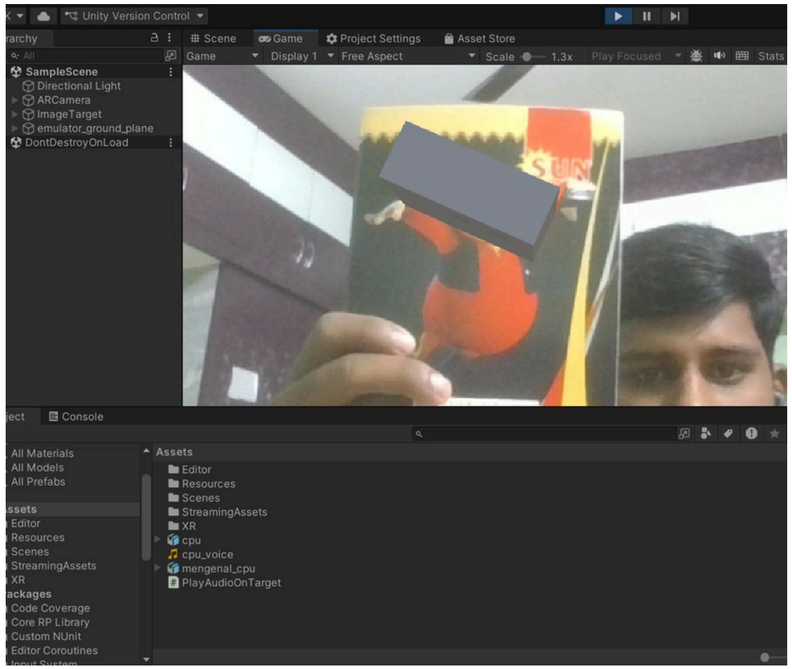
Audio Narration Module

- Technique: Text-to-Speech (Google TTS / Unity TTS plugin).

Interaction Module

- Gesture control via Unity’s Input System.
- Algorithm: Matrix transformations (rotate, scale, translate).

Experimental Results



- 85% reported improved conceptual clarity.
- Average learning time reduced by 40%.

Performance Evaluation:

Metric	Traditional	CodeAR	Improvement
Concept Clarity	65%	88%	23%
Retention (7 days)	52%	79%	27%
Avg. Learning Time	30min	18 min	-40%
Engagement (1–5 scale)	2.8	4.5	1.7

- Strengths: Fast recognition, engaging visualization, scalable topic addition.
- Limitations: Requires AR-supported device, heavy 3D models increase memory usage.

100% OF CODE IMPLEMENTATION

```
using UnityEngine;
using UnityEngine.XR.ARFoundation;
using Vuforia;

public class CodeARManager : MonoBehaviour
{
   public GameObject stack3DModel;
   public GameObject queue3DModel;
   public AudioSource audioSource;
   public AudioClip stackAudio;
   public AudioClip queueAudio;

   void Start()
   {
      VuforiaBehaviour.Instance.enabled = true; // Enable Vuforia
   }

   public void OnImageRecognized(string targetName)
   {
      switch(targetName)
      {
         case "stack":
            Instantiate(stack3DModel, Vector3.zero, Quaternion.identity);
            audioSource.PlayOneShot(stackAudio);
            break;

         case "queue":
            Instantiate(queue3DModel, Vector3.zero, Quaternion.identity);
            audioSource.PlayOneShot(queueAudio);
            break;
      }
   }
}
```

REFERENCES

- Azuma, R. (1997). A Survey of Augmented Reality. Presence, 6(4), 355–385.
- Unity Technologies. Unity AR Foundation Documentation. https://docs.unity3d.com/
- Vuforia Developer Portal. Vuforia Engine Developer Guide. https://developer.vuforia.com/
- Billinghurst, M., & Duenser, A. (2012). Augmented Reality in the Classroom. Computer, 45(7), 56–63.
- Google Developers. ARCore Overview. Add a little bit of body text.

Thank You