Advances in XR Development (7009ICT_3251)

Performance Analysis Report

S5390209

Kevin Hsu

1. Introduction

This report offers a reflective evaluation of our DineAR AR menu app created for the course. It focuses on assessing how the app's augmented reality features impacted its performance and highlights areas for improvement, based on insights from Unity's Profiler and real-world device testing.

2. Reflection on Final Product

Our app Dine AR provides a realistic and interactive 3D food with marker-based AR tracking when customers are reviewing the menu. During development phrase, we found that it is not too easy to find a proper 3D models for free as the requirements such as lightweight, quality and the correct format are hard to match. Another challenge is that as a new one to learn Unity, it's difficult to figure out all things such as interface and C#. The final product can be improved for sure, including the touch interaction with zoom-in and zoom-out, decreasing the rate of failure when scanning marker.

3. Methodology

- Devices:
  - Pixel 7a
  - iPad Air M2
  - HP Victus Laptop

- Tools:
  - Unity Profiler (Window -> Analysis -> Profiler)
  - On-device testing with printed QR markers
  - Xcode
  - MacBook

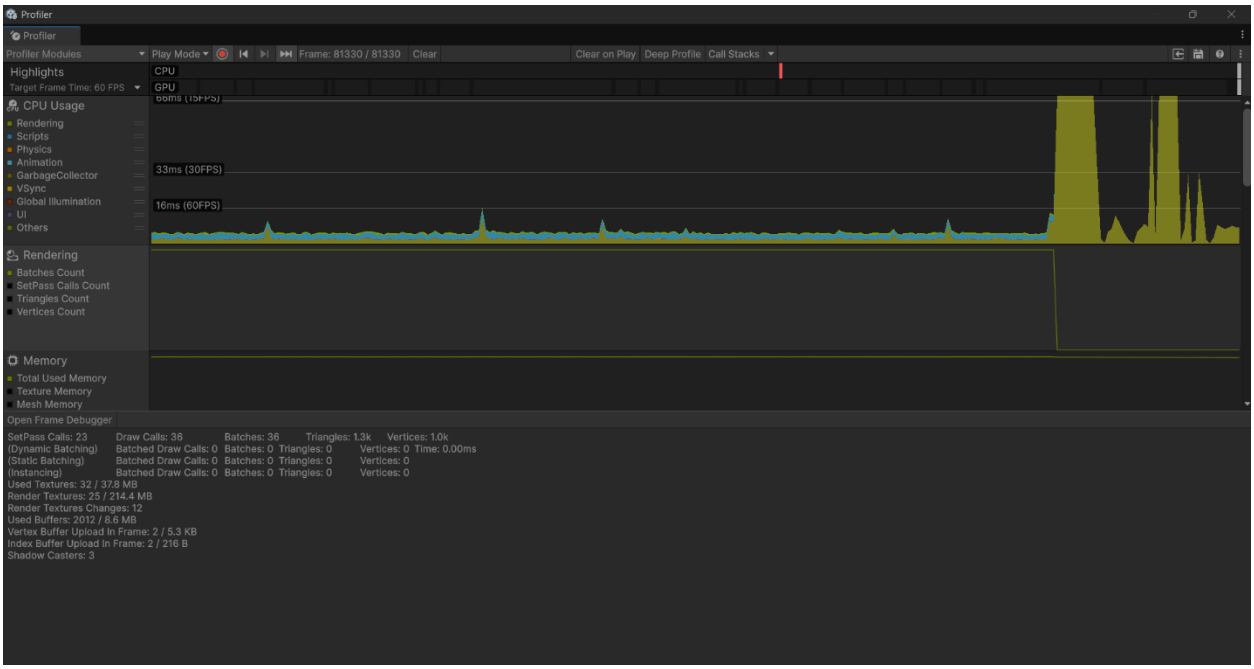
- Test Cases:
  - Scanning QR markers
  - Rendering 3D dish
  - Rotating and zoom-in/zoom-out
  - Social sharing flow

4. Performance Metrics Evaluation

Metric	Pixel 7a	iPad Air M2	HP Victus (PC)
Avg. FPS	45-50	55-60	90-100
Draw Calls	~55	~45	~41
Shader Complexity	Medium	Medium	Medium

Peak Memory	500 MB	350 MB	2.28 GB
CPU Time	~22 ms	15 ms	~17~20 ms
GC Allocations	~2 KB	~1.5 KB	~3 KB

Unity Profiler



5. Comparative Analysis

Performance testing with 3 devices (2 mobiles and 1 laptop) revealed clear distinctions in runtime efficiency, with mobile devices optimized for portability and the PC excelling in raw power. The HP Victus, running in Unity Editor, consistently achieved the highest frame rates (90–100 FPS) with the lowest draw calls (~41), though it also showed the highest memory usage at 2.28 GB, as it is in editor environments.

In contrast, the iPad Air M2 demonstrated a highly efficient AR runtime, maintaining 55–60 FPS with minimal GC allocations (~1.5 KB) and moderate CPU time (15 ms). Its low memory usage (~350 MB) and responsive rendering indicate strong optimisation of ARKit on Apple silicon. The Pixel 7a, while functional, showed the most strain—averaging 45–50 FPS with the highest draw calls (~55) and CPU time (~22 ms). Garbage collection (~2 KB/frame) occurred more frequently, likely due to slower memory throughput and limited GPU bandwidth.

Overall, while the HP Victus offered the smoothest runtime, it did not reflect real-world mobile constraints. The iPad Air M2 balanced performance and efficiency best for target deployment, whereas the Pixel 7a highlighted the need for further optimisation, particularly in reducing draw calls and memory allocation to ensure consistent performance on mid-level Android devices.

6. Conclusion

DineAR does pretty well illustrate the potential of AR being used to enhance dining out and increase interactivity in dining experiences. It works quite well on newer devices, but on older or mid-level devices like the Pixel 7a, we did experience some lag and lower frame rates. So there's still much space for improvement.

Using the Unity Profiler, along with running tests on 2 different devices, I learned about the effects of FPS, memory, CPU time, and garbage collection on performance. I learned how important it is to get the trade-off between having the app look incredible and keeping it performing as well as possible, because people are going to run it on every kind of phone or tablet out there.

We're going to have to optimize assets, reduce unnecessary memory, and improve batching to enhance DineAR. These should get the app running well on more devices. And 57% of people expect smooth digital experiences when dining out, so performance is quite important (Deloitte, 2023).

Overall, DineAR is off to a good beginning. It can be an excellent and helpful AR restaurant app with additional effort.

7. References

Deloitte. (2023). The future of restaurants
https://www.deloitte.com/global/en/Industries/consumer/analysis/future-of-restaurants-study.html