Demo: A Low-power Graphics Library for Mobile AR Headset Application Development

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CCS CONCEPTS

• **Human-centered computing** → **Mixed / augmented reality**;

1 INTRODUCTION

We present *LpGL*, a *Low-power Graphics Library* designed to extend the usage time of mobile AR headsets. *LpGL* offers a transpatent layer to the application to intercept graphics-related calls to reduce unneeded graphics processing overhead without any quality loss for saving mobile device power. Our system reduces power consumption up to ~22%, with only 46μsec of latency induced per visible object.

2 LOW-POWER GRAPHICS LIBRARY

The lifetime of state-of-the-art AR headsets, such as the Magic Leap One, is only 2-3 hours; however, longer active hours are needed to realize future mobile AR applications. A major factor affecting the battery efficiency are the computation units (e.g., CPU, GPU) for graphics rendering. Therefore, we propose Low-power Graphics Library (*LpGL*), which is a layer between the application and the GPU designed to extend the lifetime of mobile AR headsets by harmonizing the computation-quality trade-off based on the following goals.

- The AR developer should not have to modify the source code to apply our system to their application.
- Our system should be lightweight enough to not increase the power consumption due to the added computation cost.
- Despite reducing power consumption, the system should not adversely affect the user experience.

Specifically, *LpGL* offers a transparent interface to access the platform's native graphics APIs and optimizes the system's power usage using the following sub-components.

∘ **Scene Dynamics Scoring-based Frame Rate Control**: Scenes with less dynamics do not show differences in user-perceived quality even when rendered at low frame rates [1].

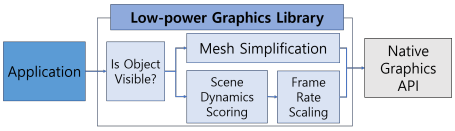

Figure 1: *LpGL* System Architecture

Scene dynamics scoring quantifies the current scene dynamics, and determines a suitable frame rate on a per-scene basis.

∘ **Mesh Simplification**: Increasing object complexity results in higher power usage for graphics rendering. *LpGL* identifies objects away from the user's core view-point and tries to reduce the number of triangles for such objects. The simplified versions of all objects used in an application are created in compile time to minimize operation-time latency.

∘ **Culling**: To draw a 3D object, an app issues "draw calls". However in the traditional graphics pipeline, rendering is performed even for objects that can not be seen in the user's field of view. *LpGL* suppresses draw calls for such un-seen objects to minimize power usage at the graphics pipeline.

3 DEMO APPLICATIONS

We present three applications to show the benefits of *LpGL*.

∘ **Floating Sphere Observation**: This application contains a static scene (no object motion), in which the spheres float around the user and are simply observed.

∘ **Sphere Shooting**: In this application, the user is asked to shoot floating spheres using a controller. This application represents a case with high level of object motion dynamics.

∘ **Abnormal Bunny Search**: This sample application asks the user to identify abnormal bunnies under three conditions: with *LpGL*, without *LpGL* and using a naïve energy saving technique, where the bunny qualities are uniformly sacrificed to meet the energy savings level of *LpGL*. This application shows how using *LpGL* can minimize energy cost without sacrificing user perceived object fidelity.

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