Latency layered rendering for mobile augmented reality

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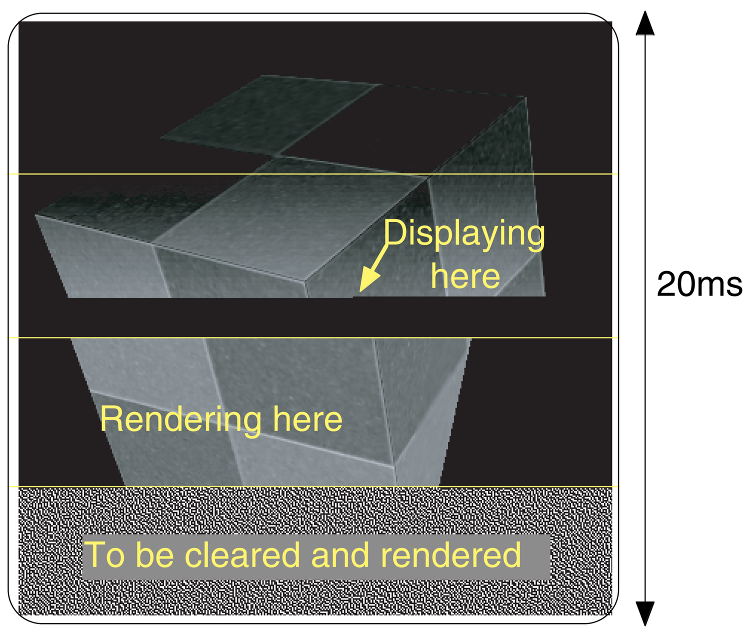
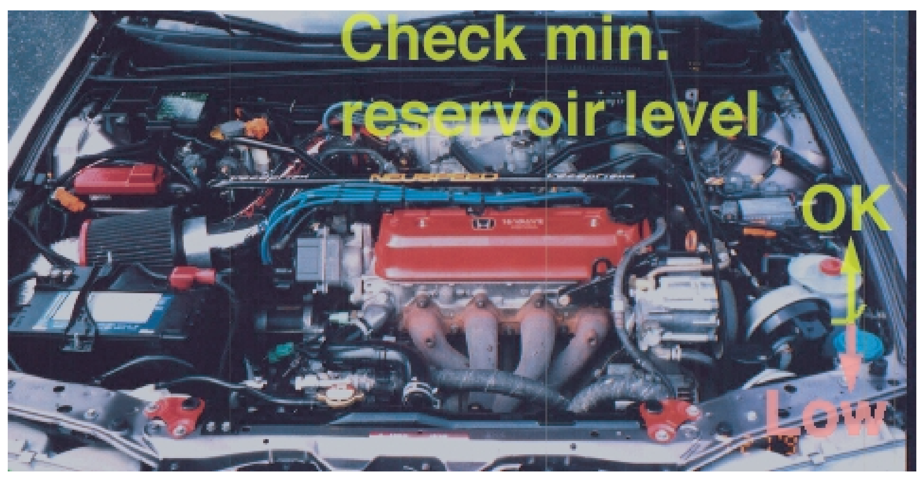
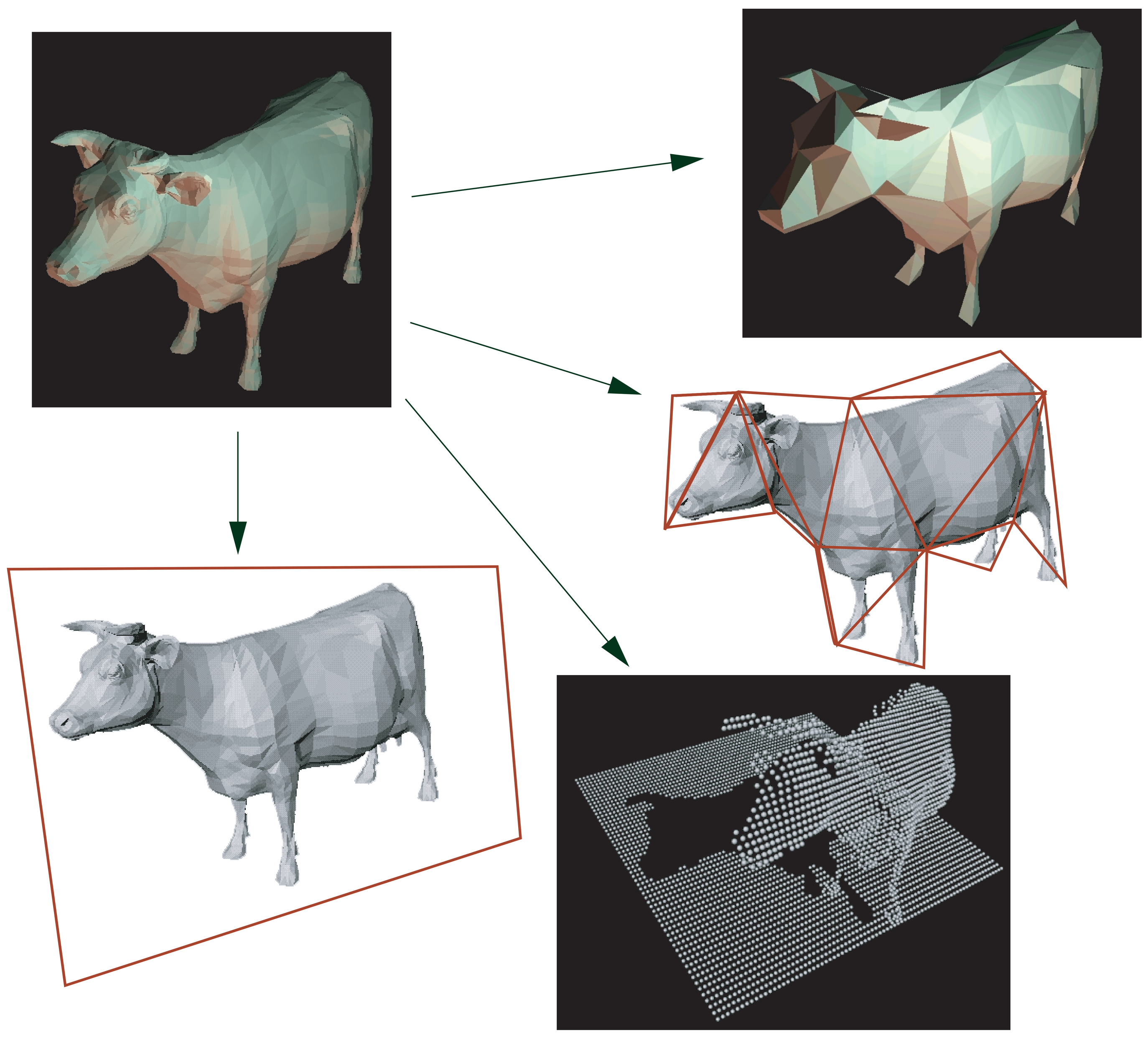
Introduction

For optically mixed augmented reality, projecting virtual objects in a stable way is a big challenge. Very low latencies between the moment the user moves his head and the moment the new image is visible are required. Previous research and estimations considering the tasks we intend to support suggest that 10 ms is acceptable.



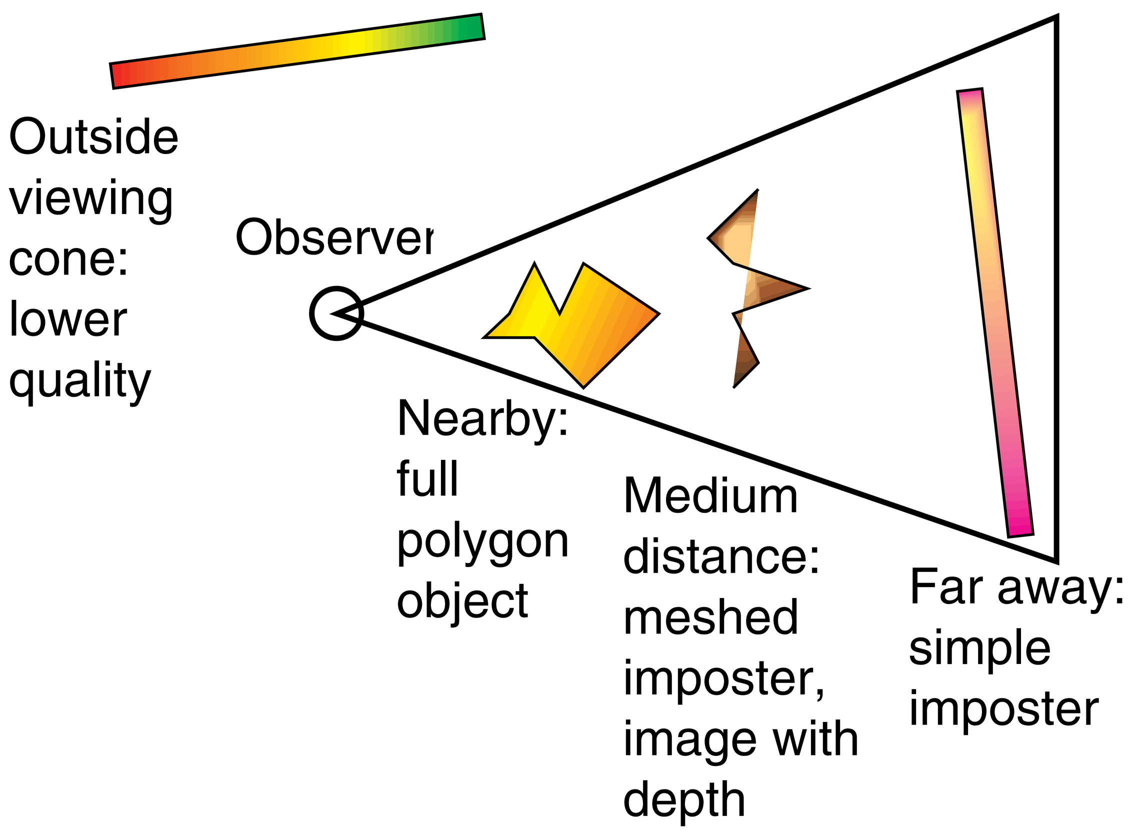
Our prototype system accomplishes a combined rendering and display latency of 8ms, and can handle approximately 350 shaded and texture mapped triangles.





Dynamic scene simplification

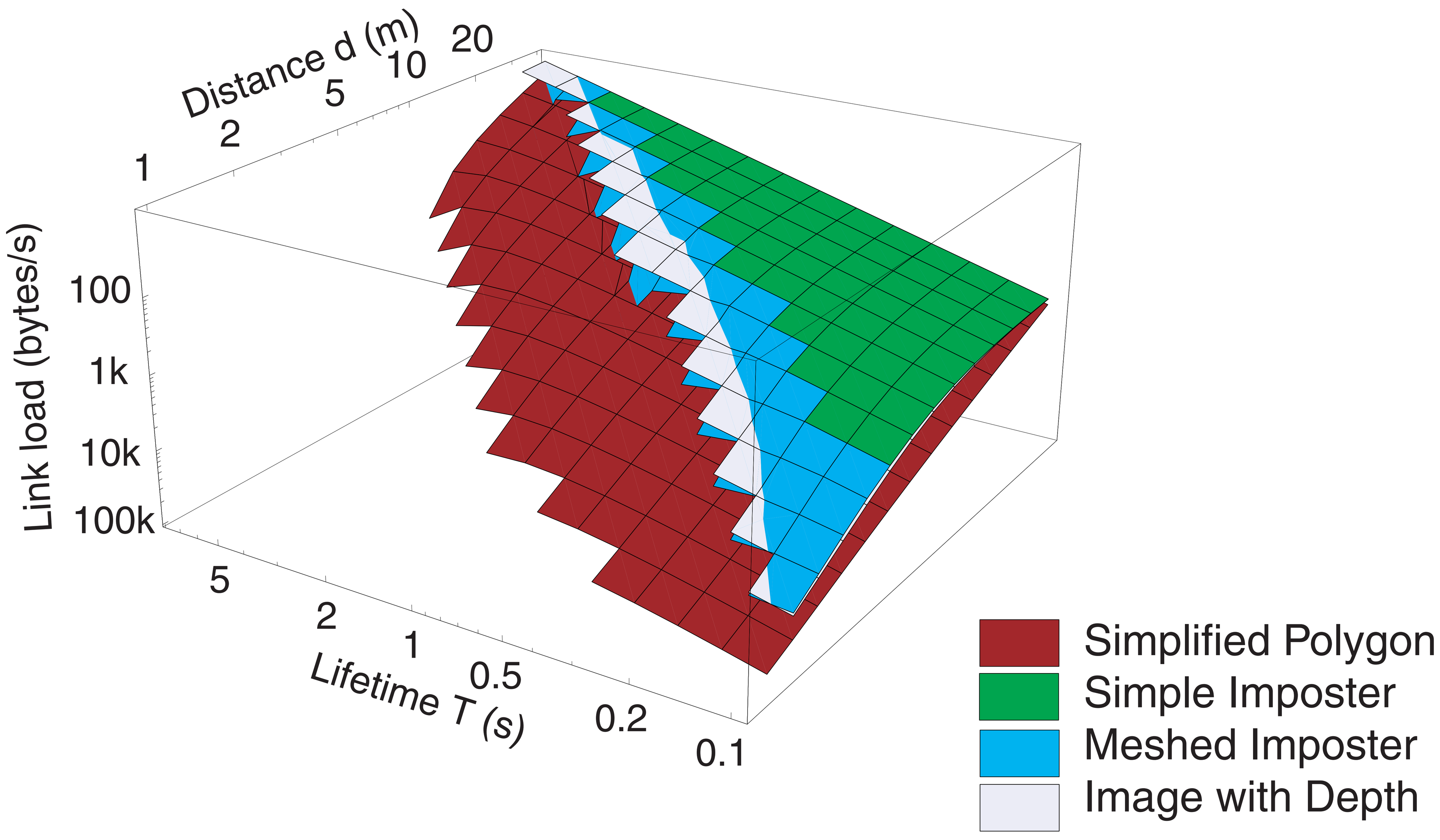
To use our system in a mobile, wearable system (the *headset*) we need to reduce the number of polygons being transmitted to and rendered in the wearable system drastically. There are several techniques available to reduce the number of polygons in a scene: per-object polygon reduction, imposters, meshed imposters and images with depth.

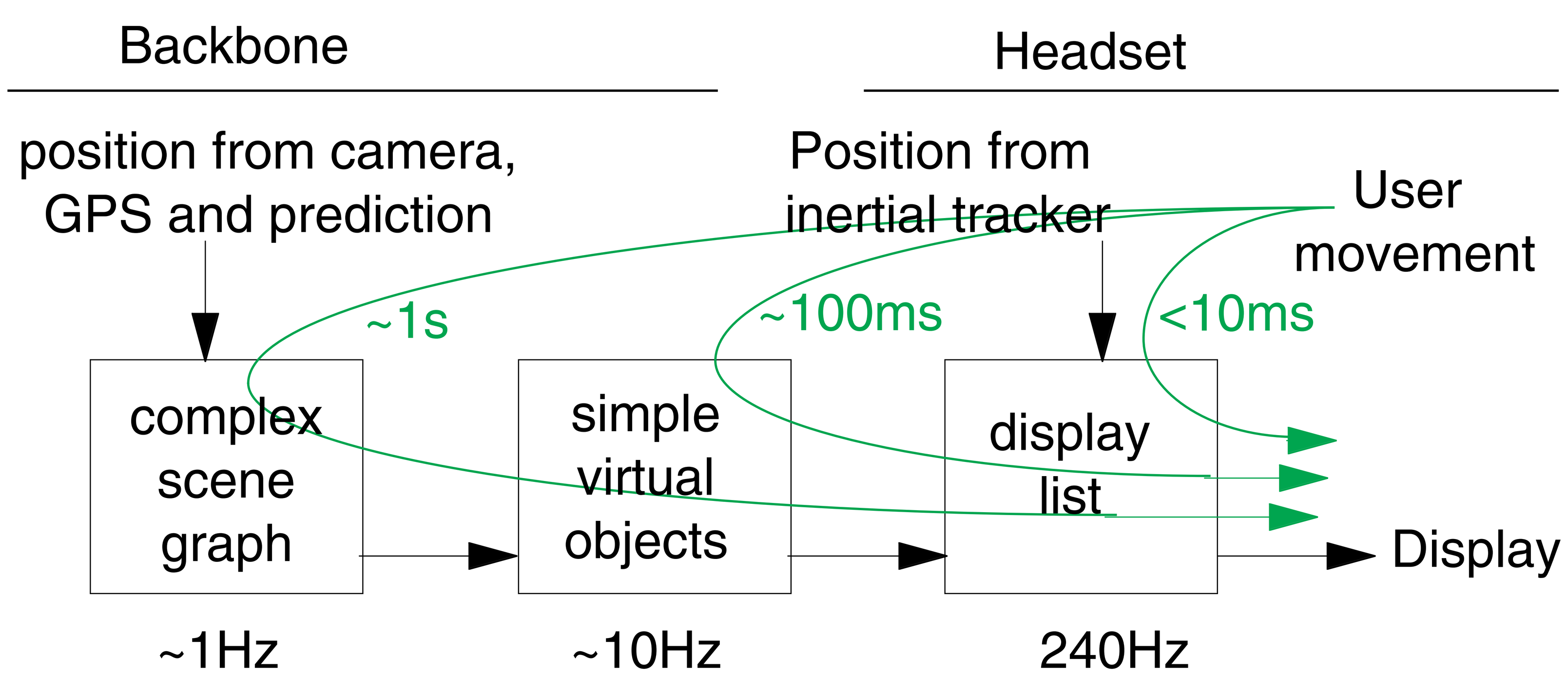


For a nearby object, the observer can look around the object very quickly, and therefore per-object polygon simplification seems appropriate. But for a distant object the observer most likely will never look at the back face, and therefore a simple imposter seems a more efficient choice, both for rendering in and load on the wireless link to the headset.

Model

We made an extensive model of the load on the headset CPU and wireless link as a function of simplification method, distance between object and observer, the size of the object and the desired life time of the simplified object. The model indicates that the load on the wireless link shows most important. Effects are as expected. Simplified models save resources and can be used down to a certain distance, depending on the size of the virtual object. For very nearby objects some distortion will be introduced by the small number of polygons available.





Latency layering

Thus we have a latency-layered system: The image is updated only 10 ms after a user moves, but with only an approximate image. More accurate updates are sent over the mobile link after 100 ms and 1 second.

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