Real-time illumination capture and rendering on mobile devices

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We present our efforts to develop methods for rendering 3D objects on mobile devices using real-world dynamic illumination from the user's environment. To achieve this, we use the front and back cameras on the mobile device to estimate the light distribution in the environment in real time. We then create a dynamic illumination map and render the object at interactive rates in a browser on the device using a web-based graphics API. This project achieves one of the goals of our related work on realistic visualization of virtual objects: to make virtual objects appear to be situated within the scene they are observed in.

I. INTRODUCTION

Virtual objects represented by 3D models can be easily rendered and interacted with using modern computer graphics tools. The appearance of the virtual objects is due to effects of interaction of light with the surfaces of the objects. In order to realistically represent the appearance of an object, it is often rendered using a virtual illumination map representing the real-world environment. To make the virtual object appear like it is a part of the real environment, we need to use the real-world illumination map to render the virtual scene.

In previous work (Ferwerda, 2014; Ferwerda and Darling, 2013) we have defined three criteria that must be met for a virtual object to appear to be part of the real world. First, the rendered images of the object must be realistic. Second, the system rendering the object must be responsive and allow natural interaction. And finally, the object must appear to be situated within the real environment. Accurate real-time modeling and rendering of the user 's illumination environment is key to this final goal.

The appearance of an object in a virtual scene is obtained by simulating how light is reflected or transmitted by the object. The appearance is made more realistic by calculating the global illumination which represents both the direct and indirect components of light transport. To make the rendered object more situated, we need to capture the user 's illumination environment in order to use it in our virtual scene.

While there has been lots of research on realistic rendering of objects in captured illumination environments, they usually require sophisticated setups and precomputations to estimate a given environment (Bodington et al, 2015; Curris et al, 2020). Our goal in this paper is to take advantage of the capabilities of modern mobile devices to capture a user 's illumination environment in real-time and to use web-based 3D graphics to realistically render 3D objects on the device so that they appear to be part of the user 's environment.

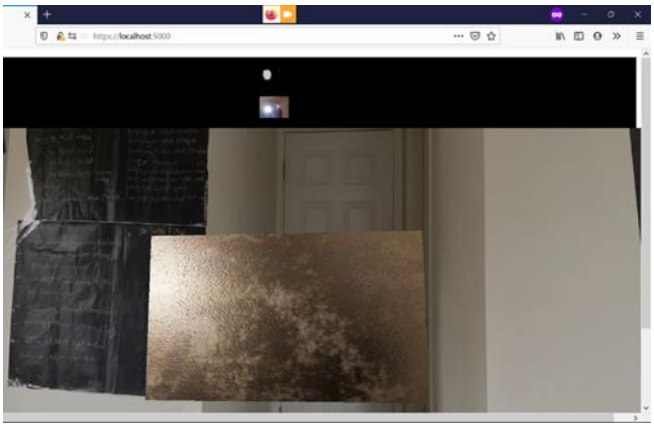

Fig. 1. Example of effects of external light source. The browser window shows a copper surface rendered by our system. At the top of the window are two small frames showing the user pointing a flashlight at the virtual surface and the light source segmented from this frame. This segmented source is then used to create a virtual light source that dynamically illuminates the virtual surface

II. CONCLUSION

In this paper we have presented our efforts towards developing a system for rendering virtual objects in real time on everyday mobile devices. The novel contributions of our system are 1) that we capture and model the user's illumination in real-time and use it to light the virtual objects, making the objects appear to be situated in the real scene; and 2) the system is implemented in HTML and JavaScript and can therefore be accessed using standard web browsers on consumer-grade mobile devices through URLs without downloading or installing any software. We see great potential use of this system to enable widespread, realistic, interactive access to digital collections.

III. REFERENCES

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