E-heritage, Metaverse

Shape and albedo recovery by your phone using stereoscopic flash and no-flash photography

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Abstract

Recovering shape and albedo for the immense number of existing cultural heritage artifacts is challenging. Accurate 3D reconstruction systems are typically expensive and thus inaccessible to many and cheaper off-the-shelf 3D sensors often generate results of unsatisfactory quality. We present a high-fidelity shape and albedo recovery method that only requires a stereo camera and a flashlight, a typical camera setup equipped in many off-the-shelf smartphones. The stereo camera allows us to infer rough shape from a pair of no-flash images, and a flash image is further captured for shape refinement based on our flash/no-flash image formation model. We verify the effective- ness of our method on real-world artifacts in indoor and outdoor conditions using smartphones with different camera/flashlight configurations. Comparison results demonstrate that our stereoscopic flash and no-flash photography benefits the high-fidelity shape and albedo recovery on a smartphone.

Background & Results

Recording 3D shape and surface reflectance are both invaluable for digitally archiving and analyzing cultural heritage artifacts. While the importance of digitally archiving artifacts is generally recognized, it is still not widely spread in many museums and libraries, mostly due to the complexity of the digitization process that comes with expensive specialized setups. To enable everybody to participate in digital archiving, a method that is simple to operate and only requires a commodity device is very much wanted.

Our method only requires one stereo camera and a flashlight. Many commodity smartphones today are equipped with this imaging setup, and we demonstrate that our method is naturally applicable to such smartphones. With this setup, recording can be conducted outside a darkroom (e.g., in an office room) and completed in a moment as it only takes two shots without any camera movement. These properties make the digitization process easy. Quantitative evaluation using synthetic images justifies our high-fidelity shape and albedo recovery pipeline. Qualitative results using images captured by a smartphone demonstrate our method's effectiveness in real scenarios.

Significance of the research and Future perspective

Using our method, people can immediately turn their phones into high-fidelity 3D scanners, facilitating the digitization of cultural heritage artifacts. We believe that our method is useful in a scenario of crowd-sourced digital archiving, which accelerates the digitization of the world's cultural heritages.

High-fidelity shape reconstruction using a stereo camera and a flashlight　　Outdoor capture　　Shape reconstruction result

Goal of the proposal

Coarse shape　　Flash image　　No-flash image

Fine shape　　Normal map　　Albedo map

Overview of the proposal