Optimizing Portrait Lighting at Capture-Time Using a 360 Camera as a Light Probe: Supplemental Materials

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INTERACTION DETAILS

In this section, we describe a couple features of our tool's interface in further detail. These are optional steps a photographer may choose to take after capturing the environment map and selecting a target lighting style. These features are designed to help the user better match their desired lighting style, either by adjusting the target based on their personal preferences and/or by aligned more accurately to the angle proposed by the tool.

Painting. As described in the paper, if photographers have a specific lighting style in mind they can manually adjust the provided targets as they please using our painting interface (Figure 1). Users express additional light regions by painting with the orange brush and dark regions with the blue brush. After such adjustment, our tool re-computes the pre-integration of the adjusted target weighting $\mathbf{f}^t$ against the transport matrix $\mathbf{T}$, and then re-runs the optimization using the adjusted $\mathbf{F}^t$ to determine the optimal orientation for the customized target facial appearance.

Alignment. Another feature that provides users with more precise control is the alignment guidance – optional real-time feedback to further aid in the reorientation process. Upon arriving close to the target orientation, the user can turn on this alignment guidance. The interface will compute the best-fit homography relating the current camera view and the target orientation view using SURF feature points [1] and MLESAC [2] (Figure 2). This homography is displayed to the user by overlaying the current camera view onto the desired view after transformation. When the images are aligned, the transformed current camera view will be vertically centered on the target view orientation.

RESULTS

Here, we present some additional results generated using our tool to showcase its flexibility in achieving more diverse target lighting styles. Using the painting interface, a user can modify targets as well as potentially create more complex targets. We use an additional light source to create some of these varied targets that can be harder to achieve.

UIST'19, October 20–23, 2019, New Orleans, LA, USA

ISBN 978-1-4503-6816-2/19/10…$15.00

DOI: https://doi.org/10.1145/3332165.3347893

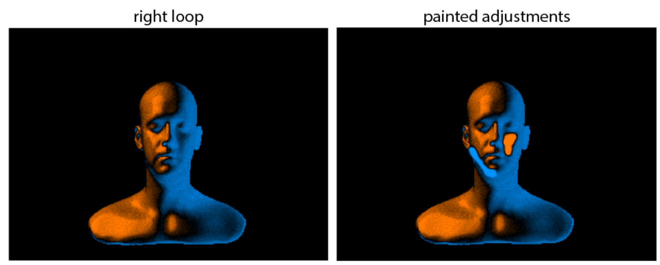

Figure 1. Photographers can manually adjust a built-in target appearance weighting function (left) using a painting interface that locally increases/decreases the weighting using a radial brush with Gaussian falloff (right). The positive paint stroke on the cheek (orange) tells the tool to find lighting that emphasizes the brightness of the key triangle under the eye, while the negative paint stroke (blue) along the bottom of the face tells the tool to look for lighting that provides extra contrast along the contour of the chin.

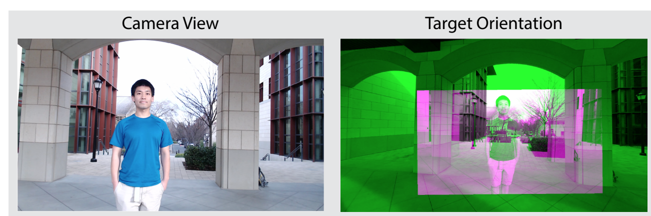

Figure 2. To aid the reorientation process our tool can compute the best fit homography between the current view and the view at the target orientation. It then overlays current view (pink) on the target view (green).

Painting. Figure 3 shows how users can adjust a target lighting style using our painting interface. The painted strokes specify parts of the face that should be emphasized. Our tool recomputes the optimal orientation to brighten the the parts of the face painted with orange (positive) strokes and darken the parts of the face painted with blue (negative) strokes. In this case the user modifies the right split style to increase or decrease brightness in the center of the face and shift the location of the transition from bright to dark.

Additional Light. Some targets require specific relationships between lights in the environment that are unachievable. Figure 4 shows how users can use a mobile additional light source to capture some of these targets that otherwise would not be attainable in the fixed environment. In these examples, the additional light is used to provide light in separate regions on the face than were lit by the environment. In addition to making more targets attainable, the light can also be used to enhance lighting styles by providing additional brightness in a dark environment, as shown for the left loop target in the fourth row of the figure. Finally, it can be used to adjust lighting in

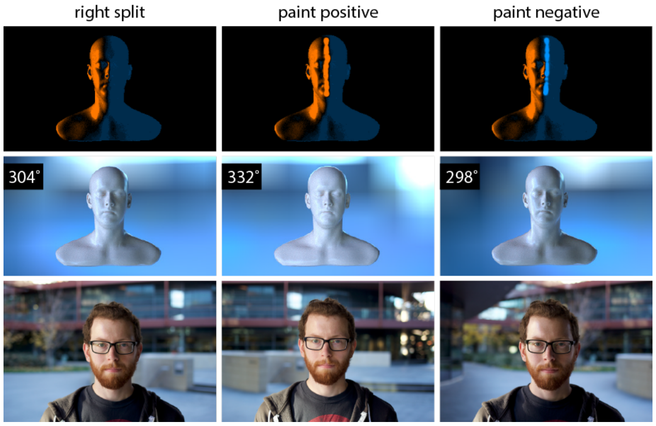

Figure 3. Initially, the built-in right split target lighting style makes one side of the face bright and the other dark (left). With the positive paint stroke (orange), our tool makes the center of the face brighter by shifting the orientation by 28° (middle). With the negative paint stroke (blue), it finds an orientation that makes the center of the face darker.

scenarios with a somewhat fixed subject orientation (eg. with a selected background) to better achieve a desirable lighting style, such as the right loop lighting in the last row.

USER EVALUATION

Experienced Versus Amateur Photographers

As described in the paper, our user study participants ranged in photography experience – including 20 amateur photographers, and 8 experienced photographers. We discuss some differences in how expert versus amateur photographers rated our tool. Our paper reports the usefulness of methods used in each task aggregated across experts and amateurs. The breakdown of ratings between amateur and experienced participants in Table 1 shows ratings were similar for task 2 and 3, the main difference is in task 1 where participants are provided no guidance. The results make sense as experienced photographers have a more concrete existing process for capturing a well-lit portrait with no external guidance. Similarly, experts rated the quality of their images produced in each task higher – all scores across all tasks reflected that experienced participants somewhat to strongly agreed (5-7 on the Likert scale) that their resulting portraits were well-lit.

Finally, Table 2 shows the breakdown for how accurately amateur versus expert participants were able to match the optimal orientation angles as proposed by our tool. Experts were able to achieve much higher orientation accuracies than amateurs in both task 2 and task 3. Provided with just a target lighting style in task 2, experts were able to manually determine orientations similar to those computed by our tool.Additionally in task 3, provided with the reorientation guidance, they were able to more accurately determine when they had achieved the optimal angle.

Additional User Feedback

In addition to surveys following each task, we conducted post-study interviews to better understand how the tool impacted their capture process.

Amateur. Many participants said that the interface increased their awareness and intentionality with regards to lighting. Many mentioned having *"no idea what I was looking for"* (P27) in the first photo, but feeling more confident when taking the third. One described that this increased confidence was due to the tool feeling as if they had *"a sort of professional in the loop"* (P13). One wrote *"I liked that it made me think beyond just the content of the photo, and also pay attention to where the light sources are. . . It worked really well too, which makes me feel like I can take much more dramatic and varied photos in a limited space"* (P26). Several commented on the usefulness of the gallery of target facial appearances as it made them realize they *"had so many drastically different [lighting] options"* (P17).

measure	population	task 1	task 2	task 3	$\chi^2(2)$	p
method:	all	4.5, $\sigma = 0.3$	5.5, $\sigma = 0.3$	6.5, $\sigma = 0.2$	18.6	< .001
useful	amateur	4.2, $\sigma = 1.4$	5.6, $\sigma = 1.1$	6.5, $\sigma = 0.7$		
	experienced	5.0, $\sigma = 0.7$	5.4, $\sigma = 1.1$	6.4, $\sigma = 0.9$		
photo:	all	5.5, $\sigma = 0.3$	5.5, $\sigma = 0.3$	6.3, $\sigma = 0.1$	7.0	< .03
well-lit	amateur	5.3, $\sigma = 1.4$	5.3, $\sigma = 1.5$	6.2, $\sigma = 0.6$		
	experienced	6.2, $\sigma = 0.8$	6.2, $\sigma = 0.4$	6.6, $\sigma = 0.5$		

Table 1. Breakdown of results: user assessment of methods and resulting photos for each task. We found a significant difference (Friedman test) between the three tasks, as well as pairwise across tasks (Wilcoxon signed-rank test), both in terms of usefulness and how well-lit the resulting images were in each condition.

measure	population	task 2	task 3	t	p
accuracy:	all	48.8°, $\sigma = 50.1°$	9.3°, $\sigma = 7.5°$	4.3	< .001
orientation	amateur	64.3°, $\sigma = 51.7°$	10.2°, $\sigma = 8.2°$		
	experienced	10.0°, $\sigma = 6.5°$	6.9°, $\sigma = 5.1°$		

Table 2. Breakdown of results: measurement of user accuracy in achieving the optimal orientation angle in task 2 versus task 3. We found a significant difference between the two tasks (Paired t-test).

Experienced. Our experienced participants expressed that the tool made them more confident and deliberate in their lighting. They said that it would be especially useful to them in complex or formal lighting environments where they needed more precise control to achieve a specific lighting style. In particular, P2 said that *"I would be satisfied with just the indication that some styles of lighting are achievable and some are not (that would also remind me of different styles that I might not be thinking about)."*

They described a number of ways in which the tool adjusted how they thought about the task of capturing well-lit portraits; specifically, experienced participants appreciated that the tool provided scaffolding to help organize their photo shoots. P16 said: *"I would use this for shooting portraits of other people so that we could be efficient. Instead of trying lots of positions hoping to get good lighting, I could use the tool to identify where and how to position the subject for the desired lighting."*

Another expressed enjoying how it changed his creative process, *"I was really surprised at how fun the tool was to use and how creative I felt using it. It really helped me see the world in a different way"* (P14). He described that by first selecting a lighting style, he used that as a creative constraint to push his creative exploration in other aspects of capturing the portraits.

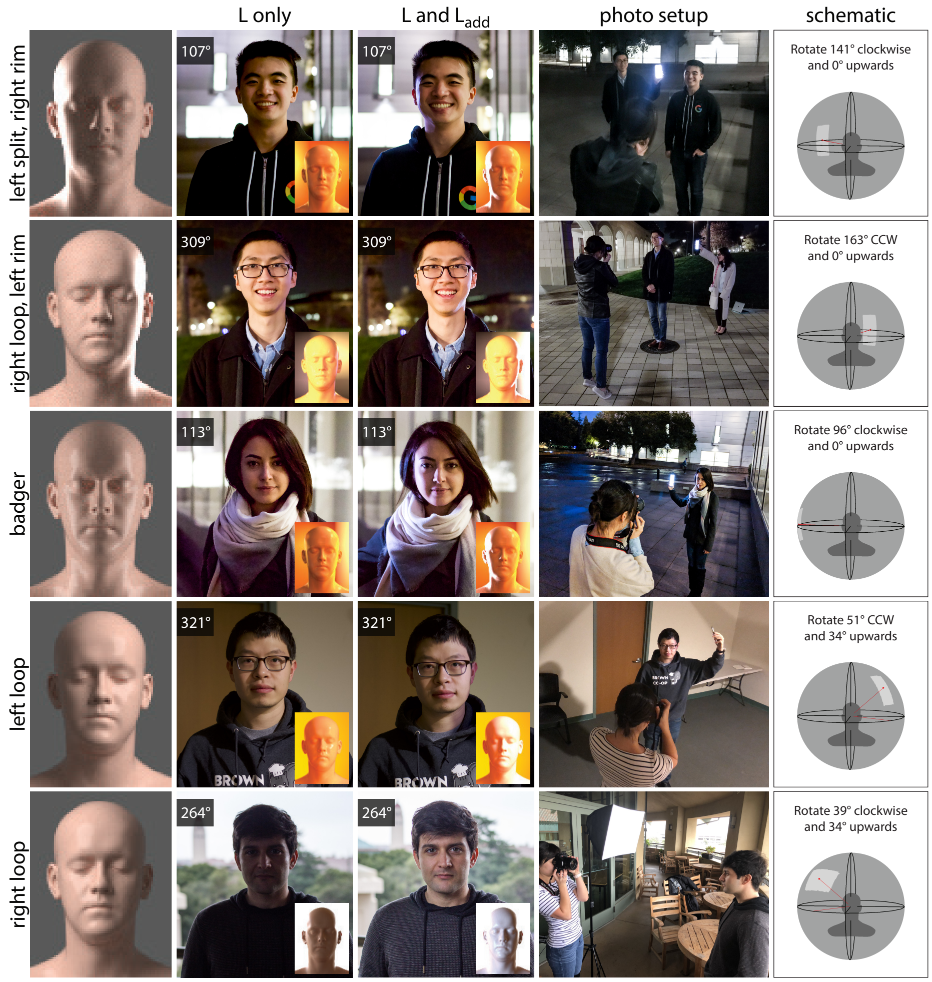

Figure 4. Our tool can suggest how to place an additional light source (a phone screen for all examples other than the last row, which uses a light box) to better achieve lighting targets such as some that are not easily attainable in the fixed lighting environment. For each of the portraits with light on both sides of the face (top 3 rows), the environment provides light on one side of the face (L only), and the additional light is able to provide the light on the other side of the face (L and L_{add}). For left loop, the additional light is used to further enhance the brightness of the lighter region of the face. For the last row, we have a desired background in the environment. Thus, the additional light is positioned relative to the fixed subject orientation to generate the desired lighting style. The schematic shows how our interface conveys the optimal orientation for the additional light source relative to the face after orienting the subject to the environment.

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