Demo: LiShield: Create a Capture-Resistant Environment Against Photographing

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ABSTRACT

The ubiquity of mobile camera devices has been triggering an outcry of privacy concerns. In this demo, we introduce LiShield, which automatically protects a physical scene against photographing, by illuminating it with smart LEDs flickering in specialized waveform. We have also designed mechanisms to unblock authorized cameras and enable graceful degradation under strong ambient light interference.

KEYWORDS

Privacy Protection; Visible Light; Camera; Computer Vision

1 INTRODUCTION

Cameras are now pervasive on consumer mobile devices. The ubiquity of these cameras, paired with pervasive wireless access, is creating a new wave of visual sensing applications. Zooming in the photo-sharing application alone, statistics report that 350 million photos/videos are uploaded to Facebook every day, majority of which are from mobile users [2]. While these technologies bring significant convenience to individuals, they also trigger an outcry of privacy concerns.

In this demo, we introduce LiShield, a system that thwarts photographing of sensitive indoor physical space, and automatically enforces location-bound visual privacy protection. LiShield safeguards the physical scenes against undesired recording without requiring user intervention, and without disrupting the human visual perception. Our key idea is to illuminate the environment using smart LEDs, and design the waveform in such a way that can disrupt the image sensors on mobile devices. In addition, LiShield can tailor the waveform for two special use cases: *(i.)* allowing an authorized camera, which shares secrete configuration information with the LED, to recover the image or video frames it captures. *(ii.)* when strong ambient light interferes with the smart LED, LiShield embeds invisible "barcode" that can convey a "no distribution" message into physical environment, allowing online servers (*e.g.*, from Facebook and Instagram) to prevent the image from being distributed.

2 WORKING PRINCIPLE AND DEMO SETUP

Nearly all consumer digital cameras, pinhole cameras and smartphones use the rolling shutter sampling mechanism [1]. When capturing an image frame, a *rolling shutter camera exposes each row sequentially.* LiShield harnesses the disparity between cameras and eyes to disrupt the camera imaging without affecting human vision. It modulates a smart LED to generate high frequency flickering patterns and aims to minimize the image capturing quality by optimizing the LED waveform. LiShield still maintains its protection while allowing authorized users to capture the same scene simultaneously without distortion. The solution leverages a secure side channel (*e.g.*, VLC [3]) between authorized users and the smart LED, which conveys secrete information such as frame timing and waveform parameters. In case strong ambient interference may degrade LiShield's protection, LiShield embeds barcodes in images/videos captured by the attacker to convey privacy policies and ensures they are detectable even after common post-processing.

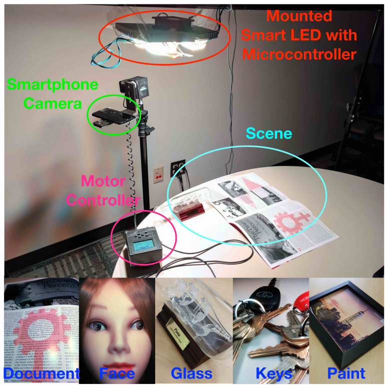

Figure 1: Experimental setup and multiple scenes we used.

In the demo, we will show our LiShield hardware prototype (Fig. 1), and encourage the audience to take photos using their smartphones while experiencing the corruption effects under LiShield. We will also demonstrate how an authorized camera (which we bring by ourselves) can circumvent the corruption effects. Besides the AC power and a table, no other facility is needed. The setup time is around 10 minutes.

3 CONCLUSION

We implemented and evaluated LiShield under various representative indoor scenarios, which demonstrates LiShield's effectiveness and robustness in privacy protection.

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S3'17, October 9–13, 2017, Snowbird, UT, USA

ACM ISBN 978-1-4503-5145-4/17/10.
https://doi.org/10.1145/3131348.3131354