HoloChat: 3D Avatars on Mobile Light Field Displays

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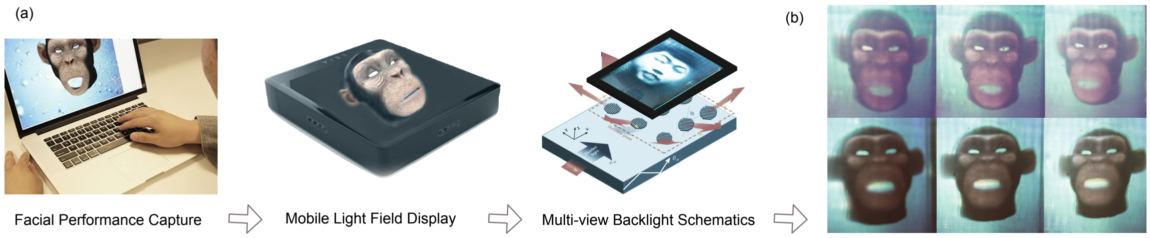

Figure 1: *Our mobile "HoloChat" system: (a) The facial performance is captured with an RGB-D camera and produces an animated virtual avatar. Rendering is performed on a mobile light field display powered by a multi-view backlight system; (b) Our holographic display viewed from different angles. Notice how motion parallax can be observed in both horizontal and vertical directions.*

1 Introduction

Holographic displays have long inspired science fiction writers and movie makers as the communication platform of the future. Why should we restrict ourselves to a two-dimensional screen if we can transmit our virtual selves in 3D? Despite striking advances in holographic display and 3D capture technologies, we are taking a step further in developing a complete prototype system suitable for mobile deployment (mobile phones, smart watches, tablet devices, etc.). We propose an efficient data-processing framework for 3D face capture, transmission, rendering, and display. Our framework combines the state of the art in mobile light field displays and depth sensor-based realtime facial performance capture. We demonstrate the first mobile holographic communication system through performance-driven digital avatars.

2 Related Work

Just like video communication has become mainstream on mobile phones and tablets, we believe that mobile holographic displays and 3D sensors will become the standard in the coming years. A great number of 3D teleconferencing systems have been proposed, but none of them are designed to fit into a portable form factor. For example, Jones et al. built a one-to-many 3D video teleconferencing system with spinning mirrors and a customized projector while 3D face is scanned with structure light projector and camera.

Lenticular based 3D displays often suffer from repeated sets of views because the field of view for each perspective is narrow. Challenges also exist in achieving motion parallax in both horizontal and vertical directions. Our display provides a seamless transition between viewing angles, which is an important feature on mobile platform as screen might be presented in either direction. In addition, because we use a collimation system with edge lighting, power efficiency can be increased, which is a desirable property for mobile devices. More technical details regarding the construction of our backlighting system can be found in [Fattal et al. 2013].

3 Implementation

In our "HoloChat" system, we first send a 3D face blendshape model of the virtual avatar to the client side in advance. The facial performance of the subject is then captured using a consumer-level real-time RGB-D camera (Primesense Carmine 1.09). Instead of transmitting the incomplete raw input frames, we produce low-dimensional animation curves that correspond to the per-frame blendshape coefficient of the facial animation. Not only does this approach enable a highly efficient communication protocol that is independent of the graphics complexity, but the rendered face is a complete model that can be watched from any angle.

Capture: Since our system is aimed for ordinary users, it should be easy to use and robust to arbitrary head motions and facial expressions (smile, speaking) during the capture process. We adopt the state-of-the-art facial performance capture technique of Li and coworkers [Li et al. 2013]. The system instantly creates a facial model of the user without any tedious calibration steps as with previous methods. While accurace facial performances of the subject can be captured in realtime, the output blendshape coefficients can also be used to animate arbitrary digital characters (see our Chimp example in the accompanying video).

Rendering and Display: We develop a customized renderer based on WebGL for the ease of delivering rich 3D graphics on our display platform. Content creators and developers do not need to worry about the rendering details of our holographic display (8 x 8 views from different perspectives) as the 3D scenes will be processed automatically in our IDE. The core of our system is a glasses-free 3D display that fits into a thin, portable form factor (display panels could be as small as $2.0 * 1.5 * 0.2$ inch). Powered by a novel multi-view diffractive backlight as detailed in [Fattal et al. 2013], the display is capable of delivering 8x8 views that covers a field of view as wide as of 60° in both horizontal and vertical directions.

4 Conclusion

We introduce "HoloChat" as a key application for holographic face-to-face communication on future mobile devices that may be equiped with light field displays and 3D sensors. While the acquisition and display fidelity is likely to increase significantly in the coming years, our prototype system presents an important stepstone toward the grand challenge of 3D teleconference. We believe that our SIGGRAPH Emerging Technologies demonstration will be a playful experience for the attendees, as they can communicate to each other remotely through 3D digital avatars. Ultimately, we hope to generate new excitements for future explorations with holographic displays and 3D communication.

References

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