A Collaborative See-through Display Supporting On-demand Privacy

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Figure 1: Users can effortlessly and instantly communicate with their co-workers by turning their screen transparent (*left*), or share information like websites (*center*) by flipping screen content (*right*) with simple hand gestures.

1. Introduction

Office workers spend a majority of their time in front of their computer screen. Therefore the screen becomes a constant visual barrier and a barrier for communication. Even workers sitting across a table have to make a high effort to communicate by either standing up or walking around the table to see each other. Transparent screens have high potential for improving this co-located face-to-face collaboration and information sharing by offering the unique ability to see screen content as well as the environment behind the screen. However, with users and their screen content being always visible to others, challenges of personal and information privacy arise. Additionally, visual interference between screen content and the environment behind the screen may affect users' performance negatively. We offer a solution by combining two transparent screens with a transparency-controlled backlight. The backlight, a piece of light guiding acrylic with edge-mounted LEDs, is opaque when turned on and transparent when off. This allows users to change the transparency of their screens on-demand and continuously, therefore controlling privacy and potential visual interference. Users can share contents instantaneously and at the same time have eye contact with their collaboration partner by interacting with the system using simple hand gestures.

2. Technology

We use two 22" transparent LCDs (Samsung LTI220MT02), each providing approximately 80% transparency. In order to control the transparency of the setup as well as to increase contrast and brightness of the screen content, we add an additional layer of light-guiding acrylic (Evonik ACRYLITE® LED) with brightness controlled LED strips around the edges in-between the screens, serving as transparent backlight. When the brightness of the LEDs is increased, the light of the LEDs is reflected inside the acrylic and therefore the opaqueness of the backlight is increased, resulting in a completely opaque screen for full brightness. When the LEDs are turned off and the screen content is faded out, the screen is transparent. In order to also provide users with the possibility to see through the display but still retain a private area for screen content, we split the backlight into two halves (vertically) and let users control each half separately. Additionally, a quarter-wave plate (MeCan MGR125) is added to resolve polarization issues between the two LCDs.

(a) (b) (c) (d) (e)

Figure 2: Possible states of the system: (a) opaque, (b) transparent flipped, (c) transparent content visible, (d) communication. Backlight is on in state (a). Additionally, the two halves of the screen can be controlled separately (e).

3. Interaction

Users can *control the transparency* of their screen and easily switch between collaborative and private mode. The system provides the following states to users: (a) opaque for private work, (b) transparent with flipped content for sharing, (c) transparent with content visible for quick communication and (d) completely transparent for longer discussions. To control the system, users can toggle transparency by making a vertical swipe gesture (swipe up = transparent, swipe down = opaque). Furthermore, users can change transparency continuously by holding their hand statically (dwell time 300ms) in front of the screen and then moving their hand up (increase) or down (decrease). The short dwell time allows us to identify the mode between toggling and continuous change while being keeping the gesture consistent. With these interactions, transparency of the screen and the screen content is changed and users can communicate with their partner without exposing their screen content. Additionally, users can control the two halves of the screen separately by performing the gesture in front of the corresponding screen half (or centered to control the whole screen). Users can easily and effortlessly *share screen content* like images, windows or other on-screen objects with their face-to-face partners. Since the screen content for one user is mirrored for the other, users can easily flip content by swiping the hand to the left or to the right.

References

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