Mid-Air Displays for Mobile Computing

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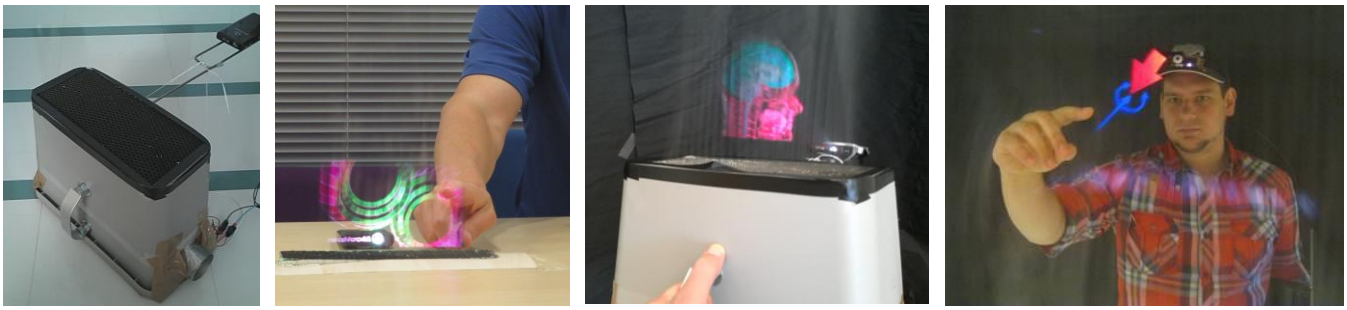

Figure 1: *(a) A prototype of a mobile mid-air display. (b) A small screen embedded to a meeting room desk. (c) Volumetric objects can be seen from a desired viewpoint when the screen is swept across mid-air. (d) A head-mounted pico projector creating mid-air enhancements.*

1 Introduction

In this poster, we describe mobile mid-air displays which can be used for mobile computing in various contexts. The previous walk-through FogScreens have been large, fixed installations for theme parks, special events and trade shows. Our recent proof-of-concept ultra-light and mobile prototypes can radically change the use of mid-air screens and they can create spatial user interfaces. They will eventually become available for mobile computing.

2 Movable Particle Screens

The idea of a "hologram" has been pursued for centuries, starting from Wheatstone's stereoscopic images in the 1830's, to the emergence of various 3D displays [1, 2] and 3DTV. A realistic display in thin air has been the Holy Grail of display technology [3].

Recent advances in displays and other technologies are enablers for new user interfaces, previously seen only in sci-fi movies and fictitious visions. Some of them can have a paramount impact on the future of computing, such as making the "hologram" possible.

The FogScreen uses a flat, thin flow of dry fog droplets as light scattering particles and enables projected images in thin air. Advances in its technology, as well as in low-cost depth cameras and other 3D sensors, and improved projectors enable ultra-light screens and new mobile applications, e.g., for ads or gaming.

The proof-of-concept mobile mid-air display consists of a fogscreen flow unit, pico projector, and an Android smartphone (for tracking and rendering), and the fog is generated in a small separate container. Figure 1a shows one of the prototypes, and Figure 1b shows a small screen embedded to a desk. The mobile screen could basically create a mid-air touch screen anywhere in a room.

Most volumetric displays create true 3D images in a confined space, which does not allow touch. Some volume slicing displays enable volumetric slices on a diffuse plastic sheet in a very limited range near the projector.

When the mobile mid-air display is tracked, it can be used as a slicing volumetric display [4] (Figure 1c). Swiping the fog plane within a tracking volume can render slices of volumetric visualizations (e.g., MRI or CT scan datasets).

A tracked mobile mid-air display can also show augmented reality (AR) on top of real objects. Unlike tablets or other solid screens, the mid-air displays enable to interact directly with the real and virtual objects in the actual spatial location [4]. The mid-air screen can pass through real objects without touching them, which is useful e.g., for delicate objects, visualization of magnetic fields, etc.

Head-mounted pico projector (HMPP) is little explored display concept. We fitted a webcam and a pico projector to a cap, and used AR software and markers to position the augmented information correctly [5]. A mobile HMPP can supplement a mid-air screen projection. For example a teacher can enhance an item on an unobtrusive mid-air screen, while facing the students (Fig. 1d).

3 Results and Conclusion

The movable FogScreen is a new concept and has many new applications. Our proof-of-concept construction is still very crude, but the device can be made significantly lighter, smaller and better. The developments with emerging technologies further support the feasibility of mobile mid-air displays. In the long term, we expect them to become a feasible technology also for consumer applications such as auxiliary mid-air displays for smart phones.

References

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