
The Tabletop is Dead, Long Live The TableTop!

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Introduction

The tabletop has evolved overtime. One may even argue that tablets may be tabletops at times. However, we can't compare the successful windows-icon-menu-pointer (WIMP) paradigm that we have used for almost four decades. But the reports of the tabletop death have been greatly exaggerated. The title of this article reflects the position advance in this article: as the tabletop displays evolves over time, a newer generation emerged. The tabletop display is not disappearing, it is evolving into newer forms because of the research conducted in this area. Our position is that the tabletop may provide support for existing systems or becoming a on-demand tabletop. The tabletop keeps evolving and we hope to provide arguments that besides its challenges, the tabletop in its new form is important for interactive systems.

The tabletop could be seen as a natural extension to the everyday desk. However, for ergonomically and legacy biases [10], our computing is performed in a vertical manner in most cases (except when using mobile devices). This

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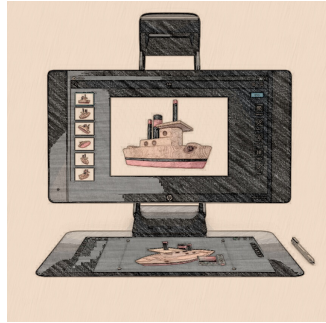


Figure 1: Sprout Sketch [9]

does bring an important aspect of what are the best use cases for the typical tabletop. Education and collaborative work, among others are possible fit for the tabletop. For example, education is a natural fit, since most K-12 (grade school) and higher-education remain using desks in their classrooms (for the most part). Collaborative work, as shown with Diamond Touch [4, 6, 6], have shown that multiple users may find useful performing certain tasks in a the same tabletop.

Tabletop Challenges

There are several challenges with tabletop that has caused the technology to be slowly adapted. The cost in some cases can be prohibited. The ergonomics constraints are not ideal for our everyday work (but ideal for certain cases, such as education). Other challenges includes 3D interaction. For example, adding 3D multi-touch adds stereoscopic perception on the tabletop that requires the user to see a minimal difference in perspective from each eye, resulting in two contrasting projections on the display. Virtual objects can be brought out with positive, negative, or zero parallax depending on the difference between the two projec-

tions making a difference in visual perception [12]. Another challenge is the **Design and interaction issues**. In other words, the lack of a unified ergonomic framework. This has given researchers reasons to think about this matter in depth. This can also be seen in the design decisions of 3D tabletops systems are usually made in an ad-hoc matter. Nevertheless, researchers have uncovered different characteristics from the user [8]. Another issue is **Visual Illusions**. This may create problems during selection and manipulation (see [5]).

Position: The Ever Evolving Tabletop

Even with all of those challenges mentioned prior, the tabletop has evolved. Our position is that tabletop as an augmented device or device on-demand plays a more important role. In other words, adding it to an existing desktop, AR experience, or on-demand when needed (converting an existing desk into a tabletop – see following section). This doesn't happen overnight. It takes time. Bill Buxton, in TechFest 2013, mentioned that new ideas and technology takes 20 years to reach Maturity [3]. This is self-evident if we look at the time line for touch (and multi-touch) technology, with our first single-touch device in 1960, touch-screen terminal in 1972, camera-based touch in 1979, and multi-touch systems in 1981 and 1982 [11]. If we look at the introduction of the Diamond Touch (tabletop) in 2001 [4] (20 years since 1981) and the introduction to the iPhone (where multi-touch became pervasive) in 2007, seems to correlate with Buxton's assertion. While Buxton's assertion may be an educated guess, it is true that technology takes a while to mature. Once it does mature, it may take some additional time to become ready for ubiquitous use. In 2014, HP released *Sprout* [9]. A commercial desktop computer clearly inspired by previous research in tabletop, in particular the BenDesk [?] (shown in Figure 2). The HP *Sprout* is a demonstration of how the tabletop can augmented a



Figure 2: BenDesk [13]

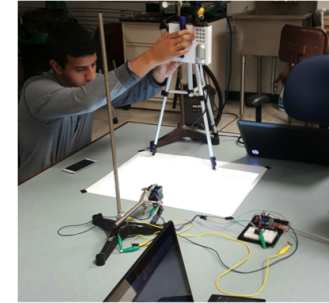


Figure 3: Portable Tabletop

current system. Research has demonstrated that extending the tabletop (or extending the desktop to have a tabletop environment) can be beneficial for the workplace [2]. Tabletop has also received attention to extend multi-touch in 3D dimensions [7]. Mixed-Reality has also been used to extend the tabletop [14]. Additional examples can be found in [1, 10].

Use Case: Portable Tabletop

As mentioned earlier, one of the potentials of tabletop is to convert the everyday desk for school into a smart desk. We have tried a few iterations. Building a desk to replace an existing desk is an option but may prove to be expensive for some schools. An alternative option was to create an existing desk into a smart desk. We called this the Portable Tabletop. This led us to develop the Portable Tabletop. While only an early prototype, it showed promising results. This portable desk included a projection board (in our case a white board), a three-prong clamp with bosshead, one support ring stand (similar to the ones used in chemistry labs), one camera tripod, two laser line generators (120 degrees), one LG PF1500 projector, one infrared light (808nm) filter (with m12 infrared light - internal filter glass), one 3.4 mega-pixel usb camera module with S mount holder. The software includes TUIO, TouchInjector, and OpenCV

3.1.0 using C++. Except for the projector that cost around \$500 dollars, everything else can be obtained for less than \$200.00 dollars. This provides access to a tabletop using any desk. We are not the first to think about extending the desk by projection and in particular extending it for the use as a tabletop. This includes the Touchjet Pond, HP Sprout, and the Light Touch. For example, LBO's (Light Blue Optics) Light Touch Projector provided a small tabletop space with interactive features. The system is no longer available (since October 2013 since LBO was acquired by Promethean) but it provides an interesting idea of advancing the tabletop.

Conclusion: The Future of the TableTop

We have discussed that even with challenges facing the tabletop, the tabletop has evolved over time. Most importantly, the tabletop is becoming a supporting device for existing systems or device on-demand.

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