A Digital Clipboard for Real-Time Observations and Multimodal Annotations of Team Performance

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Figure 1: Viewing a block building activity with an observational tool (a). The user can write on the observational tool (b) and make annotated videos by tilting the tablet up (c). Recorded videos take the form of movable post-it notes (b).

Abstract

Performance evaluations, both for an individual and for teams, can be conducted with survey-based observational tools. These observational tools could be on paper and clipboard or on a tablet or computer. In either case, they aren't necessarily able to provide the context and evidence needed to transform otherwise vague feedback into clear, helpful feedback. We contribute a new design for a tablet-based digital clipboard application to address this problem. Our implementation supports the same style of handheld, pen-based annotation as traditional clipboards, while adding new capabilities like capturing and embedding video annotations in digitized versions of standard observational tools. Observers enter observations and annotations in real-time using a creative combination of pen, touch, and spatial gestures of the clipboard itself that is designed to be efficient and, as much as possible, enable observers to maintain visual focus on the team they are evaluating. Early results include observations recorded during lab-based, iterative design testing for teams of students working together to build a structure out of blocks.

Keywords: Tablet, UI, pen, touch, video recording.

Index Terms: Human-centered computing-–Interaction design—Interaction design process and methods-–Interface design prototyping; Human-centered computing-–Visualization —Visualization systems and tools

1 Introduction and related work

In hospitals trainers, instructors, and/or evaluators observe perioperative teams to evaluate their performance. These observers fill out survey-based observational tools using clipboards or digitized versions of the tools on a handheld phone or tablet. State-of-the-art observational tools use Likert-scale ratings which facilitates standardization but does not capture the context or evidence for why or when they gave a rating. Thus it can be hard for the evaluated team to fully understand the ratings and how to improve. Some environments support video capture, but in many scenarios (e.g. hospitals, military, etc.) the observers are senior experts who don't have time to review the video after the live session. Even systems that timestamp annotations require significant time to conduct post-hoc analyses to match relevant video clips with annotations. Focusing the observer's attention to important parts of the scene is important for visual analysis, but recordings may not hit this. Thus, there is a need across many contexts to develop tools for real-time observations of team performance that include clear feedback, complete with evidence.

This context suggests several important design considerations:

- An improved system must add to the current evaluation standard (i.e. paper/digital observational tools) instead of replacing them.
- A digital device solution should be handheld and usable while standing; thus the observer may need to use one hand to hold the device. Furthermore, it should be comfortable for sessions ranging from 5 to 60 minutes.
- The observer should not need to provide more context/info after the session.

Tablets are accessible enough to be a viable candidate for any sort of notetaker. Tablets can type, write notes with a pen and take videos. Videos can be an observational tool. Thus, one should be able to use a tablet as a "digital clipboard" to gather more complete notes and give more complete feedback. However, in typical practice today, notepads/pdf editors don't simultaneously utilize a tablet's multi-modal data collection options. The tablet's UI is not optimized for when one hand holds the tablet.

To overcome these limitations, our solution builds upon related work in spatial user interfaces and pen and tablet computing. Several other researchers have sought more efficient or intuitive tablet-based interfaces via combined touch and pen input [1,2].

Our design builds most closely on Pfeuffer et al's research which covers thumb + pen interactions [1]. Pfeuffer et al portray this idea of opening a half radial menu centered on the thumb; the user can then drag their thumb to an option for a specific action or a mode switch. Our design builds upon this by utilizing more features of the tablet, i.e. the camera and the gyro.

Our approach is also closely related to Zhang et al's work [2]. They use a custom electrode ring placed on the tablet's bezel to detect where the hand is and positions an arc-shaped thumb menu at the edge of the screen near the hand holding the device. This is

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exactly the feature we are looking to support; however, Zhang et al accomplish this with hardware augmentation while we want an app that can be run on normal tablets.

2 The Digital Clipboard

Our "Digital Clipboard" prototype is implemented in Unity Technologies' Unity Engine and runs on a Samsung Galaxy Tab S7+. Figure 1 shows the app in use during a team block building task which is a stand-in for a perioperative team scenario that motivates our work. Say an observer notices that the anesthesiologist isn't checking the patient's vitals often enough. Traditional observational tools might capture this as a "2" on the Likert scale and, perhaps, some quick notes in the margin of the observational tool. With the Digital Clipboard, observers can do the same, but, in addition, they can take a video of the event, annotate the video itself (e.g., circle the vitals monitor), and associate the video (like a sticky note) with the relevant question in the observational tool. Later the anesthesiologist can watch the video to see the justification for a lower rating.

2.1 Pen-based Ratings and Annotations

As shown in Figure 1b, the prototype displays an observational tool which the observer can write on with their finger or pen. This is the baseline functionality. It acts like traditional clipboards where the observer can provide answers to questions and jot down extra notes in the margins or between questions.

2.2 Seamless Mode Switching for Video Annotations

While the observer is limited with their number of fingers and reach from the hand holding the tablet, they can still tilt it well. Therefore, we use the gyroscope to switch between two modes in the app as shown in the sequence of images in Figure 1. While tilted down, the app is in writing mode. The app can enter video recording mode when the tablet is tilted up. This fluent motion keeps the observer's attention on the scene and eases their visual analysis. In recording mode, the observer can annotate the video in the same way they do the observational tool. Two seconds after making an annotation, it is saved and disappears. When the observer tilts the tablet back down to a comfortable writing angle, the video is saved and writing mode resumes.

A few moments after the video is saved, a "video post-it-note" appears. Figure 1b shows the observational tool with such video post-its. This video post-it can be dragged to an appropriate spot. If the video explains a particular score, it can be placed next to that question. Clicking a post-it starts a video player to watch the recording associated with that post-it. By accompanying the questions with these videos, we not only provide context, but also evidence for any ratings and comments.

2.3 Reviewing Observations on the Timeline

The videos attached to an observational tool could be especially useful in a post-simulation debrief showing specifically what went well and what needs improvement. The moment motivating an annotation naturally happens before the observer starts making the annotation. Thus, in video playback the completed annotations appear on screen a couple of seconds before their associated timestamp to help account for the observer's reaction speed. These annotations focus one's attention to ease visual analysis. Touching the screen makes a timeline appear telling the observer where in the video they are. They can tap it to skip to that part of the video. Markers on this timeline indicate the start of making an annotation. Thus, it may take little time to review even long videos by skipping directly to the points of interest.

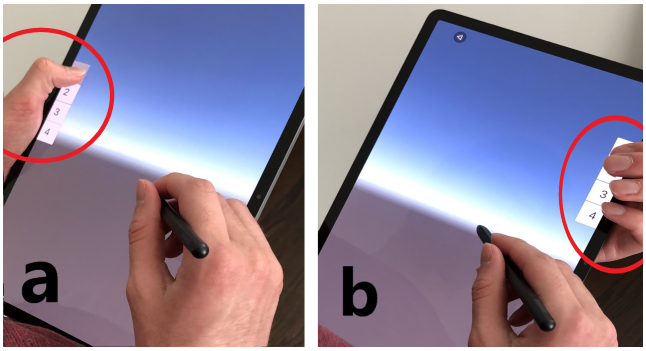

Figure 2: Finger menu mockup (circled) for holding the tablet with the non-dominant hand's thumb up (a) versus holding the tablet with the non-dominant arm around the tablet's back (b).

2.4 Additional Functions via Pen + Limited Touch

Although not yet implemented, we have designed several strategies for extending the interface by incorporating "limited" touch input from the observer's non-dominant hand. We describe this touch input as limited because in our motivating scenarios the observer must stand and we, therefore, assume the non-dominant hand's primary responsibility must be to hold the tablet.

There are two main holding styles to consider, both depicted in Figure 2. We anticipate observers may swap between the two; thus we designed the mockup finger menu pictured in Figure 2. Tapping the left or right of the screen near the bezel causes 4 buttons to appear near the touch point. In Figure 2a's holding style the thumb can hit the buttons. In the other style the 3-4 fingers curling around the edge can click the buttons. These buttons could be used to switch the pen between writing, erasing, and selecting.

3 Observations from Iterative Testing

To refine the Digital Clipboard, we asked lab-mates to work as a team to construct a simple structure out of blocks while we rated their performance. We modified typical observational tools used to assess perioperative teams to fit the task, and used the Digital Clipboard to assess performance on 9 scales during a 12 minute session (Figure 1). We found that it was easy to swap between the two modes. Making annotations in the former was easy and intuitive. However, the tablet wobbled while annotating a video due to having a single supporting hand. Videos need to be taken somewhat preemptively; if an event of interest is fast and comes with no warning, then the observer cannot record it in time.

4 Conclusion and Future Work

We introduced a prototype tablet application which seeks to increase the effectiveness of evaluation of perioperative teams, and potentially teams in general. Our next step is to turn it into a proper application where the observer can annotate more than just one observational tool and save their annotations and video post-its. We intend to look more into how people hold tablets and create menus/interactions utilizing the observer's holding hand.

References

[1] Pfeuffer, Ken, et al. "Thumb+ Pen Interaction on Tablets." *CHI*. 2017.

[2] Zhang, Yang, et al. "Sensing posture-aware pen+ touch interaction on tablets." *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. 2019.