

IllumiPaper: Illuminated Interactive Paper. Klamka, et al. CHI. 2017.

What are the core research questions addressed by the work?

- Where, how, and when paper-integrated, visual feedback can support user interactions in paper-and-pen user interfaces?
 - Which interaction techniques and applications are suitable?

What motivates the work?

- The provision of visual feedback, e.g. to communicate pen or system states, in paper-and-pen user interfaces remain challenging

How does the work understand the usage, capabilities, and limitations of paper?

- Attributes paper success to its simplicity, sensory richness, versatility, ubiquity
- Affordances of paper for writing and sketching provide unique advantages over digital media
 - Evident in active reading tasks when highlighting words, marking graphics or adding drawings
- Paper found to be the most direct, flexible, and intuitive way to annotate documents
- There is a growing need of digital integration into our daily life
- While maintaining the unique properties of paper, powerful software tools and computing functionality should be combined with paper for added digital value
- Properties of texture, tearing, folding, etc. are not easily replicated with digital displays

What is the target application domain of the work?

- The applications the work implements to demonstrate its proposed concept target the application domains of personal, educational, and professional daily-life activities
- Specifically, they developed applications in the domains of:
 - Education (multiple choice tests, mathematical applications, interactive tool palettes)
 - Entertainment (grid puzzles)
 - Paper forms

What are some proposed extensions to paper proposed by the work?

- Enable more robust visual feedback when interacting with paper, thereby making the medium more active than passive and enabling a tighter coupling with the digital domain

What design constraints or objectives guided the work's implementation of the proposed extensions?

- Articulates following design goals:
 - Utility: visual feedback usefully integrates physical & digital user experience
 - Integration: preserve advantages of physical paper
 - Versatility: support many applications
 - Simplicity: easy to use & integrate w. workflow

How are the proposed extensions implemented?

- A four component system: a digital stylus (Anoto-enabled Maxell DP-201), different augmented papers, a smart controller clip, and an android device
 - Augmented paper components: EL segments, EC seven-segment displays, capacitive touch fields, resistive paper identifiers, etc.

- For input and visual feedback
- Smart clip: attachable controller for the various components that communicates with the Android device
- Android device: Central controller that communicates with both the digital pen and the smart clip

What findings have been obtained from either the implementation process or an evaluation of the proposed system?

- The visual feedback provided by the system has potential in lowering cognitive load for certain tasks
- The work assumes that paper-thin and flexible microprocessors will emerge and further display technologies will be made possible in the near future
 - Current platform is limited by form factor, maximum addressable channels, and even in space-saving design of traces
- Assumes that next miniaturized and completely printed iterations will support a fully-integrated approach
- The integrated components have a short lifetime
- The paper proposes the following design goals, which could be generalized for integrating feedback in paper: utility, integration, versatility, and simplicity
- The paper also proposes a fairly exhaustive design space to guide future integration of feedback
 - Dimensions: Feedback position, visual types, feedback time, and fundamental feedback components
 - Fundamental feedback components: feedback for controls and widgets, validity feedback, smart request feedback, layout feedback, feedback for motion sequences, and extended input