HoloDoc: Enabling Mixed Reality Workspaces that Harness Physical and Digital Content. Li, et al. CHI. 2019.

What are the core research questions addressed by the work?

- How do people use physical documents in light of easily accessible digital versions of said documents?
- How can we enable users to make use of physical documents, while preserving the advantages of digital content?

What motivates the work?

- Studies on paper and digital displays predate the adoption of modern, high resolution displays and mobile devices by office workers
- Preserve favored elements of physical paper & augment w. digital capabilities

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

- Physical paper is naturally tangible and inherently physically flexible
- Physical paper documents naturally support multi- and intra-document layouts, in addition to providing simplistic readability and supporting physical gestural navigation
- Paper is incapable of providing the ability to search, view dynamic multimedia content, and make use of indexing
- Physical paper is quicker to access, supports physical navigation, has convenient markup abilities, and is amenable to dynamic physical layouts

What is the target application domain of the work?

- Document processing: Any sort of work involving interacting with documents
    - Focused on academic work, but claims to be easily extensible
    - Particularly tandem physical-digital document use

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

- Binding the physical and the digital via implementing functionalities along the reality-virtuality continuum: interactive paper, interactive sticky notes, interactive whiteboards
- Extending paper to support searching, access to additional and dynamic content
- Using a physical sticky note as a proxy for virtual content in the real world
    - Relies on feedback in the virtual world so as a result, their physical forms can be manipulated an repositioned as needed, while the associated virtual content remains available
- Creating a virtual space that enables indexing and grouping of digital content that physical content can easily be copied over to
- Support interaction with content in 3D space

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

- Searching was a function that participants were more likely to use digital tools for
- Cross-referencing is easier on physical paper
- Participants in their design study underlined the value of supporting the archiving and retrieving of resources anytime and anywhere

- In the motivating design study, the authors found that there is an overwhelming desire for printed documents to exhibit elements of interactivity and not just be “hard paper”

How are the proposed extensions implemented?

- Microsoft HoloLens HMD for augmented reality display and gesture capture
- Neo Smartpen for input capture
- Fiducial markers for tracking physical paper documents in space

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

- It is challenging for users to place virtual elements at the right position and rotation for an optimized reading experience. Sorting and filtering features and other predefined spatial arrangements may help reduce “digital messes” and the user’s workload
    - Users have diverse preferences of repositioning virtual elements, and they may change their desires based on the current task - it is important to allow for easy customizations of virtual layouts
- Current limitations of the headset: The weight of the headset and the limited field of view affects the user’s posture and is somewhat straining; the FOV affects text readability and may induce motion sickness; there is currently limited availability of academic resources from which online resources could be easily obtained and embedded on printed documents; object tracking accuracy is limited by the resolution of the built-in camera