Hand-rewriting: Automatic Rewriting Similar to Natural Handwriting. Hashida, et al. ITS. 2012.

What are the core research questions addressed by the work?

- How to enable computers and human users to write and erase freely on the same piece of paper?

What motivates the work?

- Limitations of existing augmented paper systems
- Annotations by pen cannot be modified
- Representations of augmentation (e.g. projection) are not persistent and are aesthetically displeasing

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

- Handwriting with pen and regular paper is something which all generations are familiar with
- Preserves paper as a medium for annotation and augmentation
- Adds dynamism through computer-controlled ink addition and removal

What is the target application domain of the work?

- Not specified, technique appears generally applicable

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

- Enable handwritten content to be selectively erased by the computer system without an eraser
- Enable additional content related to hand-drawn sketches to be dynamically displayed on paper in print-like colour

How are the proposed extensions implemented?

- Use of chromic material, for which the appearance and disappearance of color can be controlled by external stimuli
    - Use of thermochromic material and photochromic material, both of which can be controlled without contact by heating or exposing light
- Use of a “ThermoErasure” system for erasing
    - Comprised of a FriXion pen with 24 colors, a spiropyran paper whose underside is coated with black paint, a laser controlled by a galvanometer scanner, and a glass heater
    - For temperature control, thermal conversion of laser light is used
    - A galvanometer scanner is then used to control the irradiating position of the laser light in high resolution
    - When the light hits the black paint coated on the underside of the paper, it is converted into heat, and when the temperature reaches about 64 °C, the colors of local areas are erased. The galvanometer scanner can control a laser beam to an accuracy of 0.068 mm (in the case of letter-size paper). To accelerate the speed of the color erasure, a glass heater warms up the paper from below.
    - A picture of the paper is captured with an overhead camera, and the erasure area is automatically determined by computer processing. This automatic

determination of the erasure area based on a camera image has a variety of potential applications.

- Use of a “PhotoScription” system
    - The PhotoScription system is comprised of spiropyran-coated paper, a UV mirror, and a UV projector. A single color appears locally on the paper when UV light pattern is projected. Color is determined by the kind of spiropyran applied on the paper, and not by the wavelength of the UV light.

What are the results of the work? What are the implications of the results for future designs and implementations of paper-based technologies?

- More of a technical contribution
- Potential improvements: Quality of colour-forming in images, implement functions that enable users to choose effects, system size
- Suggested application domains: Interactive paper questionnaires, automatic painting, coediting, &c.