Paper Computing
Old technology in a modern world

Nadir Weibel <weibel@ucsd.edu>

Distributed Cognition and Human Computer Interaction Laboratory
University of California San Diego
"I've finally achieved a paperless office."
Proto-writing

From tokens to envelopes and tablets
(~8,500 BC - ~ 3,500 BC)

Hieroglyphs & Alphabets

Egyptian Hieroglyphs (~ 2700 BC)
Semitic Alphabet (~ 1850 BC)
Phoenician Alphabet (~ 1050 BC)
Early Pens and “Paper”

Reed Pens and Papyrus (Egypt ~3’500 BC)
Paper

One of the four great inventions of China

- Hemp wrapping paper (~ 200 BC)
Paper-making

Cai Lun (105 AD)

- Paper used to wrap objects (for writing from 300 AD)
Printing

Ancient China, 6th century AD
- woodblock printing / wood movable printing
Europe?

Paper: 11th century AD in Spain, 1276 in Italy, 1320 in Germany, 1490 in England

Printing: Gutenberg press 1436 - 1450
Publishing

Industrial revolution (19th century)
- Rotatory Printing Press
Printing Technology

1837: Chromolithography (Color printing)
1900: Flexography (Relief printing)
Digital & Personal Printing

1957: Dye-Sublimation (Pocket photo printers)
1964: Dot-matrix printing
1969: Laser Printing (Gary Starkweather @ Xerox)
1976: Inkjet Printing
2003: 3D Printing
WWW and Hyperlinks
Paper?

This is a beautiful and ingenious machine, very useful and convenient for anyone who takes pleasure in study, especially those who are indisposed and tormented by gout. For with this machine a man can see and turn through a large number of books without moving from one spot. Moreover, it has another fine convenience in that it occupies very little space in the place where it is set, as anyone of intelligence can clearly see from the drawing.

A. Ramelli. Le diverse et articiose macchine del Capitano Agostino Ramelli. Paris, 1588
V. Bush’s Memex

A memex is a device in which an individual stores his books, records and communications and which is mechanized so that it may be consulted with exceeding speed and flexibility. It is an enlarged intimate supplement to his memory.

Atlantic Monthly, "As we may think" July 1945
The Office of the Future

An in-depth analysis of how word processing will reshape the corporate office

...a relatively small but fast-growing group of companies will have moved into the office-of-the-future environment. The leap forward will be led by the “papermakers” – those companies that are involved primarily in generating, modifying, or moving paper.

These pioneers will have hooked together word-processing equipment into office systems to transfer information electronically and to move it into and out of central electronic files. For them, it will be the start of the paperless office

Paperless Office?

“I’ve finally achieved a paperless office.”
The myth of the Paperless Office

"Rather than pursue the ideal of the paperless office, we should work toward a future in which paper and electronic document tools work in concert and organizational processes make optimal use of both."
Digital Desk

Pierre Wellner, Xerox EuroParc 1992
Electronic Paper

Xerox Gyricon

E-Ink

XLibris

Fujitsu E-Paper
E-Readers & E-books

Amazon Kindle

iRex iLiad

Barnes&Noble Nook

Kobo eReader

Google Alex
Linking to Information

(a) Barcode, EAN-13

(b) 2D barcode

(c) RFID tag
Encoding Information

(a) Sem@Code

(b) QR Code

(c) QR-code of a L. Carroll poem

(d) QR Code with face design
Dataglyphs...
Conductive Ink

(a) Conductive barcode grid

(b) Inductive pen

c) Conductive Pencil
Anoto Digital Pen and Paper
Anoto Pattern

- Absolute coordinate addresses
- Basic pattern
  - Above
  - Below
  - Left
  - Right
  - 1.5mm
  - 0.3mm

Anoto pattern
Interactive Paper Toolkits

Paper Augmented Digital Documents
(François Guimbretière, U-Maryland / Cornell)

Paper Toolkit
(Scott Klemmer, Ron Yeh, Stanford)

iPaper / iServer
(Beat Signer, Nadir Weibel, Moira Norrie, ETH Zurich)
PaperPoint Presentation Tool

Mobile presentation tool
Non-linear presentations
Paper-based real-time annotations
Digital whiteboard
Multi-pen support
brainstorming

Beat Signer, Nadir Weibel, Moira Norrie
ETH Zurich, 2006
ButterflyNet

Ron Yeh, Scott Klemmer, Stanford 2006
ButterflyNet: Video
Interactive Paper

Digital pen technologies bridge the paper-digital divide by enabling user actions on paper to be tracked. Handwritten notes and sketches can be digitally captured. Active areas on paper can be defined that link to digital content and services by simply touching them with the pen. Possibilities abound for publishing new forms of interactive documents and providing paper-based interfaces to applications.

We have developed a platform and range of tools to support the rapid prototyping and production and testing of all kinds of interactive paper applications.

iPaper

iPaper is a framework that supports the rapid development and deployment of interactive paper applications. Active areas can be defined on paper and linked to various user services. By providing an extensive library of active components, users can extend the range of applications without having to do any programming. iPaper was developed around the iServer, a general cross-media server, which means that active areas can represent a wide range of physical and digital media including web pages, images, video, databases and RFID tags as well as application programs.

iGesture

iGesture is a general and extensible framework to support the development of interactive gesture recognition algorithms. The API makes it simple for application developers to create their own gesture-based interfaces. It is device independent and can be used with any touch-based device.

N. Weibel, B. Signer, A. Ispas, M. Norrie, ETH Zurich, 2008
PaperProof

- Digital Authoring of documents
- Proof-editing on paper
- Automatic integration of edits
Livescribe Multimodal Smartpen

- Record and replay synchronized ink & audio
- 2/4/8 GB memory
  - 32'000 / 64'000 / 128'000 pages
  - 200 / 400 hours recording
- 96x18 OLED Display
- Open application platform / SDK
Pen and Paper Computing @ UCSD
ChronoViz

Paper-Digital Workflow for observational Research
UbiSketch: Ubiquitous Sketching for Social Media


Minnesota is easy for... friends...

\[
\text{Packing Theory}
\]

weird apocalypse

"Brains"

Bad Idea

Before insulating:

After insulating:

I'm getting too old to climb around in attics.

yay!

We are done.}

I am a paper deadline!
Tap & Play & Write-n-Speak


Write-n-Speak Video

Add Multimodal Content
Paper Material

- quick start guide
- control panel & widgets
- magnetic paper
- post-it notes
- digital pen
- charger
- notebook
- blank paper
- stickers (white & transparent)
Interactive Books for Children
THANK YOU!

Nadir Weibel <weibel@ucsd.edu>

Distributed Cognition and Human Computer Interaction Laboratory
University of California San Diego