Paper + Digital Applications
for mobility and collaboration

Ron B Yeh
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UNIFOR
Augmenting Notebooks
Designing & Building
Paper Interactions
Background
Research
Fluid Interaction with Paper
Interviews and Observations
Los Tuxtlas Tropical Rainforest
We also observed that...

The process of capturing data is easy, but...

...the data are not.
Clear Difference in Advantages

Paper Notebooks
- Robust, ∞ “Battery”, ...

Computers
- Search, Storage, Sharing, ...
Digitizing Pen Technology
Digitizing Pen Technology
Augmenting Notebooks
Automatic Association

Notes + Photos associated by TIME

notes @ 4:43pm

photo @ 4:44pm
Manual Association

Notes + Photos associated by Inked Gesture (Hotspot Gestures)
Video #0
Hotspot Linking
ButterflyNet Browser

March 20, 2005 1:53 pm
- March 21, 2005 5:11 pm
No tags

March 20, 2005 2:09 pm
- March 21, 2005 5:12 pm
No tags
piper cannabinus, sesquiterps smells...light greedy piper species
Legume Araceae...cornregua...
Mutualism (myrmecophily)
ants live in twins of the aracea ants defend plant (Dan Jensen)
Stipules...hollow
ants live here.

"behavioral biology" of ants

Food for ants
Extrafloral nectary
Round cup
ants pseudomonomex (genus) obligates competition btw. ant species.
difference in degree of ant defense ability?
ontogeny vs. development
plants don't want ants when they are young. what do they do now??
Dan Jensen
compared ant and nonant acacia species.
nonmyrmecophilous acacia = lots of chew marks

induction compounds produced when attacked
acacia...rhizohoria gracilis
palm tip herbivory
preferable herbivory makes holes in leaf herbivory

Can leaf morphology deceive herbivores?
(hypothetical)
induction?
birds target eaten-looking natural enemy plants to find insects
probably won't make bad chemicals if it has these other defenses.

*toxcanramphastopterus* sulfurates
almost always found in 2's
110 sp orchids here

CAM...cactus
epiphytes..."desert"

epiphyllum

March 20, 2005  2:49 pm
- 4:16 pm
No tags

March 20, 2005  3:07 pm
- 3:23 pm
No tags
induction → compounds produced when attacked

araceae → rhizophora gracilis

palm, tip harvesting
prefallable herbivory makes holes
not from herbivory

can leaf morphology deceive
herbivores?

(hypo) → induction?

birds target eaten-looking
natural enemy plants to find insects

probably won't make bad
chemicals if it has time

other defenses

* toucan

ramphastidae as Sulfurates,
almost always find in 2s

?? 110 sp orchids here → cattaceae

CAM → cacti (??)

epiphytes → "desert"

epiphyllum

banyan → heliconia

herbaceous → Lauraceae + persicaria
stem buds ground

palm - chamaedorea (??)

all nutritious

eaten by one baffle

diary

- principle of resource allocation

- differentiation of resources

- total biomass allocated to

- female sex → female is smaller?

- slower

"skulltonering" → type of herbivory

beetles

"gawling" → wasps and flies

another herbivory type

insect change morphogenetic structure

of fall (when it's young)

pavonia arvata

galled tree, important in

canopy → maccaceae

March 20, 2005 3:07 pm

No tags

March 20, 2005 3:27 pm

No tags
July 22, 2005

at Seaview Lake I found an interesting specimen:

September 21

5:35 pm

- 5:58 pm

Tags: Picture of Acorn

acorn cap.

This cap was clearly carried from its original location.
Video #1
Browser & Spreadsheet
Navigate by Pen

Browse using the Physical Notebook
Longitudinal Evaluation

Used By:

Field Biologists at JRBP/Stanford

NASA Researchers
(Death Valley, Alaska Toolik Field Station)

Anthropologists at Intel Digital Home

Design Students at Stanford
Augmenting Walls and Tables
Photo Wall

Download Photographs
Video #2
Photo Wall
Video #3
Network Monitoring
Map-Based Queries

Search for Photographs
Video #4
Twistr Game
Designing & Building Paper Interactions
Reduce, Recycle, Reuse (R3)
A Paper Applications Toolkit

http://hci.stanford.edu/paper/
Goals for the Toolkit

**Lower the threshold** for building this class of pen-based paper + digital user interfaces.

Provide a **high enough ceiling** that talented designers/developers can do interesting research and build useful systems.
Pipeline for building a Paper + Digital Application

- Design and Print the Paper User Interface
- Architect the Application Logic and Connect the Sheets to Pens and Other Devices
- Write custom GUIs and Event Handlers
Designing and Printing

Create the Paper Interface in Illustrator (or some other tool) and Export to PDF
Add Active Regions through Java Code or the Interactive Designer
Export to Pattern-Augmented PDF
Print to Laser Printer or Wide-format Inkjet
History of Programming Languages
Rex 3.00
1982

PostScript
1982
Event Handlers

Add behavior to your Paper UI by attaching code that will be run whenever a person clicks on, drags on, writes on one of your active regions.

```java
toBeClickedRegion.addEventHandler(new ClickHandler() {
    public void clicked(PenEvent e) {
        < do something >
    }
});
```
Building Blocks

Sheets, Regions, Handlers
Devices, Pens
Applications
Toolkit
Powerpoint Advancer Example
Turn Pen Events into Keystrokes

```java
public static void main(String[] args) {
    Application app = new Application("Advancer");
    Sheet s = new Sheet(new Inches(8.5),
                       new Inches(11));
    Region r = new Region("Button", 1, 1, 4, 2);
    r.addEventHandler(getMarkHandler());
    s.addRegion(r);
    app.addSheet(s,
                 new File("data/Grid/App.patternInfo.xml"));
    app.addPen(new Pen("Primary Pen"));
    PaperToolkit toolkit = new PaperToolkit();
    toolkit.startApplication(app);
}
```
public static void main(String[] args) {
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}
Add one Sheet

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```
One Patterned Region

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    toolkit.startApplication(app);
}
We need at least 1 Pen

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    PaperToolkit toolkit = new PaperToolkit();
    toolkit.startApplication(app);
}

Ask the Toolkit to Start the App
private static EventHandler getMarkHandler() {
    return new GestureHandler() {
        public void handleMark(PenEvent e, GestureDirection dir) {
            switch (dir) {
                default:
                    RobotAction robot = new RobotAction();
                    robot.keyType(KeyEvent.VK_RIGHT);
                    robot.invoke();
                    break;
            }
        }
    };
}
private static EventHandler getMarkHandler() {
    return new GestureHandler() {
        public void handleMark(PenEvent e,
                               GestureDirection dir) {
            switch (dir) {
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                    RobotAction robot = new RobotAction();
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                    robot.invoke();
                    break;
            }
        }
    };
}
To Key Stroke

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                    robot.keyType(KeyEvent.VK_RIGHT);
                    robot.invoke();
                    break;
            }
        }
    };
}
```
private static EventHandler getMarkHandler() {
    return new GestureHandler() {
        public void handleMark(PenEvent e, GestureDirection dir) {
            switch (dir) {
                case NE: // do something
                    break;
                case E: // do something different
                    break;
                default:
                    RobotAction robot = new RobotAction();
                    robot.keyType(KeyEvent.VK_RIGHT);
                    robot.invoke();
                    break;
            }
        }
    };
}
Swing Example

Click, LISTENER1 notified, LISTENER2 notified.
R3 Example

Paper UI

Sheet

Region

CLICK, LISTENER1 notifed, LISTENER2 notifed.

PenEvent
Location IN Region
PenID :
Video #5
Other Paper Applications
AudioGuide Example

We started out with an idea of making a **mobile audio interface** for biologists, and decided that a **tourist map** would be a good first step.
The Map
Map ➔ Adobe Illustrator
Add Active Regions to the PDF

In this case, we used the R3 Acrobat Designer. You may alternatively choose the pure programmatic route, by writing Java code to define the active regions.

```java
public class AudioGuide extends Application {
    < lots of stuff >
}
```
public class AudioGuide extends Application {
    public static void main(String[] args) {
        AudioGuide guide = new AudioGuide();
        PaperToolkit p = new PaperToolkit();
        p.useApplicationManager(true);
        p.loadApplication(guide);
    }
    < lots of stuff >
}
public class AudioGuide extends Application {
    public static void main(String[] args) {
        AudioGuide guide = new AudioGuide();
        PaperToolkit kit p = new PaperToolkit();
        p.useApplicationManager(true);
        p.loadApplication(guide);
    }
}< lots of stuff >
Conclusions

Audience for the R3 Paper Toolkit is HCI Practitioners like yourself!
Open Source Software
Can evolve based on your feedback

http://hci.stanford.edu/paper
Questions???

ronyeh@cs.stanford.edu