PaperCP: Explore the Integration of Physical and Digital Media for Active Learning

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A Question

How many of you attended the HCIL Symposium last year?
Two-Way Communication in Active Learning

• Involve students in activities for learning
Fully Digital System for Active Learning

• Classroom Presenter [Anderson, ’04]
  – Data transfer, archive and display
  – Reading and writing experience, tangibility, display size, cost
Gap Between Paper and Computers
Our Solution
PaperCP: Integrate Paper and Computers

- A paper-based Interface built on the Classroom Presenter digital infrastructure
PaperCP in Action (1)

- Printed slides are handed out to students

One-minute Feedback

- What one or two ideas discussed today capture your attention and thinking the most?
PaperCP in Action (2)

• Responses are submitted from paper
PaperCP in Action (3)

• Submissions are reviewed and discussed
Previous Work

• Computer-supported Learning/Teaching
  – Classroom 2000 [Abowd,’00], LiveNotes [Kam,’05], Classroom Presenter [Anderson,’04]

• Paper-Computer Integration
  – PADD [Guimbretière, ‘03], PapierCraft [Liao,’05]
  – PaperPoint [Signer,’05], Palette [Nelson,’99]
  – DigitalDesk [Wellner,’93], PaperWindows [Holman,’05]
Building Blocks
Communication Model of Active Learning

- **Shared delivery channel**
  - (often, slides + annotation + submission)

- **Anonymous submission channel**
  - (often, written answers)

- **Individual delivery channel**
  - (occasionally, prepared slides)
Model Implementation in PaperCP

- Paper interface for students
- Computer interface for the instructor
Challenges(1): Physical-Digital Mapping

- Anoto pen traces handwriting in real time
- PADD links digital & physical documents

Anoto [Anoto, 2002]  
PADD [Guimbretière, ’03]
Challenges (2): Weak Feedback on Paper

- Use ink as feedback
- Issue commands by drawing

Selective submission gesture

Deleting gestures

PapierCraft [Liao,05]
Preliminary Experiments
Testing in A Real World

- Deployed in a realistic Software Engineering class at Univ. of Washington
- Eight students + one instructor
- Within-subject setting comparing the Tablet PC and paper interface
Results: Feasibility and Usability

• The paper interface is feasible
  – Work well with the digital infrastructure

• The paper interface is usable
  – Well integrated with Active Learning
  – Comparable to the Tablet PC interface in supporting student submission
Results: Lessons

• Physical arrangement
  – One-slide-per-page layout is not good
  – Unstapled pages are not good

• Efficiency
  – Printing needs speed-up
  – Pen switching is annoying

• Feedback
  – More real time feedback is needed
Future Work

• Improve print layout
• Enhance real time pen-top feedback
• Mix paper and computer interfaces
• More rounds of experiments
Take-away Messages

• PaperCP is a paper-based interface to support 2-way communication in Active Learning, combining the merits of physical and digital media

• Preliminary experiment has shown PaperCP’s feasibility and usability, as well as challenges such like printout layout and feedback

• More information
  – http://www.cs.umd.edu/~liaomay,~francois
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