InkChat

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Teaching with Technology
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Teaching and Learning are Collaborations
Collaborative Software

- MS Share Point
- Yahoo Messenger
- CmapTools knowledge modeling kit
- Slideshare
- Skype
- Campfire
- Dabbleboard

Dabbleboard
The whiteboard reinvented
Visualize, explore, collaborate

Enabling integrated collaborative teams to enhance productivity and speed time-to-market.
Common Features

- Slide shows
- Whiteboarding
- Voice chat
- Video chat
- Image capture
"I think you should be more explicit here in step two."

from What's So Funny about Science? by Sidney Harris (1977)
Technical Content

Missing:
- Mathematics
- Diagrams, graphs
- Geometric figures
- Technical knowledge base
- Document markup

- Scientific software connections
  (Maple, Mathematica, GeoGebra, R,...)
Isn’t a shared whiteboard, with the ability to save images enough?????
Technical Content

No!
\[ D = \frac{1}{c^2} \frac{d}{dt} \frac{d}{dt} = \frac{1}{c^2} \frac{dP}{dt} \]

\[ D^2 = \frac{1}{P^2} \frac{P_0 - P}{P} \sim \frac{1}{P^2} \quad (1a) \]

\[ D^2 \frac{K_0}{3} \frac{P_0 - P}{P} \sim \kappa \rho \quad (2a) \]

\[ D^2 \sim 10^{-53} \]

\[ \zeta \sim 10^{-26} \]

\[ P \sim 10^8 \text{ L, J} \]

\[ x \sim 10^{10} (10^{11}) \text{ J} \]
Einstein’s Blackboard

• Einstein to receive honorary doctorate at Oxford, May 1931.

• Lecture at Rhodes House.

• Board retrieved and preserved by Edmund (“Ted”) Bowen.

• Nice to look at, but content is trapped.
Digital Ink

• Location, time information, sometimes also pressure and angles.

• Capture online pen strokes, *not* images.

• Suitable for
  • **Recognition** algorithms
  • **Semantic** grouping
  • **Annotation**
  • **Manipulation**: search, transformation, archival.

• Problem: Multiple vendor-specific formats.
Ink Markup Language (InkML)

W3C Recommendation 20 September 2011

This version:
http://www.w3.org/TR/2011/REC-InkML-20110920/

Latest version:
http://www.w3.org/TR/InkML

Previous version:
http://www.w3.org/TR/2011/PR-InkML-20110510/

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Pen-Based Math

• Input for CAS and document processing.
• 2D editing.
• Computer-assisted collaboration.
Pen-Based Math

• Different than natural language recognition:
  • 2-D layout is a combination of writing and drawing.
  • Many similar few-stroke characters.
  • Many alphabets, used idiosyncratically.
  • Many symbols, each person uses a subset.
  • No fixed dictionary for disambiguation.

\[ \sum_{i} z^2 \quad i + z = \sin \omega t \]
The Research

\[ e^x = \int e^x \, dx = \lim_{\beta \to \infty} \frac{\beta^x}{x^\beta} \]

\[ f(s) = \sum_{i=0}^{d} c_i P_i(s) \]

\[ C(t) = (1-t)\bar{C} + tC_{\text{targ}} \]
The Software

InkChat

An Online Collaborative Digital Ink Environment

Enter Room ID  Start InkChat
Prior Generations

• 2002 Pocket PC:
Prior Generations

• 2002-2008 Tablet PC:

\[
\sin \alpha = \frac{2 S_{\triangle ABC}}{b \cdot c}
\]
Prior Generations

- 2008-2013 Java Application:
InkChat (Java Version)

- Skype and GTalk add-on to the Java application.
Problems

• Requires installation:
  • Big hassle for someone to use only once in a while or on all their machines.

• Limited portability:
  • Users expect versions on Android, iOS, Windows, Mac OSX, Linux, etc...
  • Incompatible software bases
  • Flakey, moving APIs

• Need to support multiple devices.
  • Nowadays a single user will want to work across many devices.
Solution

• Use browser infrastructure.

• JavaScript is not a great language for large projects, but......
  • It is ubiquitous: Telephones, tablets, laptops, ...
  • Libraries for many UI elements
  • Our new recognition algorithms are fast enough 😊

• Rapid development:
  • Prototype developed in 3 months by 3 students.
Current Generation

\[
\left[ \frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} + \frac{\partial^2}{\partial z^2} \right] \psi = -\frac{\partial^2}{\partial z^2} \psi
\]

\( a^2 + b^2 = c^2 \)

\((a+b)^2 = 4 \left( \frac{1}{2} ab \right) + c^2 \)

\( a^2 + 2ab + b^2 = 2ab + c^2 \)

iPhone 5

\( a^2 + b^2 = c^2 \)

\( \alpha \)

\( \beta \)

\( \gamma \)

\( \theta \)

\( \phi \)

\( \psi \)

\( \epsilon \)

\( \delta \)

\( \zeta \)

\( \eta \)

\( \theta \)

\( \iota \)

\( \kappa \)

\( \lambda \)

\( \mu \)

\( \nu \)

\( \xi \)

\( \omicron \)

\( \pi \)

\( \rho \)

\( \sigma \)

\( \tau \)

\( \upsilon \)

\( \phi \)

\( \chi \)

\( \psi \)

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\( \zeta \)

\( \eta \)

\( \theta \)

\( \iota \)

\( \kappa \)

\( \lambda \)

\( \mu \)

\( \nu \)

\( \xi \)

\( \omicron \)

\( \pi \)

\( \rho \)

\( \sigma \)

\( \tau \)

\( \upsilon \)

\( \phi \)

\( \chi \)

\( \psi \)

\( \omega \)
Simple Interface with device-adapted menus
Ink Controls
Collaboration:
Different Viewports from Different Devices

\[ a^2 + b^2 = c^2 \]
Collaboration

Document Annotation

Pointers for Discussions
Embedding in Other Environments
Cloud Integration

• Save or load files to cloud storage
  • Dropbox
  • Google Keep
  • Others possible

• Previous work to store user profiles
  • Save cloud of ground-truth labelled symbols (corrected/accepted)

• Future work to store user-defined brushes
Application Web Site

InkChat

An Online Collaborative Digital Ink Environment

Enter Room ID  Start InkChat
Application Web Site: Found Objects
Conclusions

• Teaching technical subjects requires new tools.
• Drawing, mathematics and technical text is required.

• The treachery of images.
• Needed:
  • Math handwriting recognition.
  • Easy geometry and diagrams.
• Even a little goes a long way....
• ... there is a lot of opportunity for future development.

• Document mark up.
• APIs to scientific software.
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