NiCE Formula Editor

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Teaser

http://mi-lab.org/projects/nice-formula-editor/
Motivation
Educational software on Interactive Whiteboards (IWBs)

- „need for adequate training in order to use IWBs to their full potential“ [1]

- „teachers‘ development with IWBs depends on easy and frequent access“ [1]

Survey with 190 participants

- 49% at more than one institution
- 33% also at companies
- 69% less than 8 hours/week
- 56% access only during workshops
Still there is a need:

- 95% of university staff teach use blackboards or whiteboards in their lectures (46% every lecture)

Current usage (Top 4):
- 77% for explanations
- 77% for sketching
- 56% for notes
- 49% for calculations

How can we support this?
%% Low frequency
First define a sample rate

\[ y = \sin(2\pi f_1 t) \]

plot(t, y);

%% Add high frequency
Next add a second higher frequency

\[ y = \sin(2\pi f_1 t) + \sin(2\pi f_2 t) \]
Computer Algebra System Tools

- CAS tools are underutilized for problem solving [1]
  - Too rigid and formal
  - Need transparent explanations of computations
  - Must support free-form 2D input

Requirements:

Make it **as easy as doodling** on a traditional whiteboard

Integrate **interactivity** to allow playful exploration

Utilize **power** of CAS
Development starting point

- StarPad SDK [1]: 6+ years of research
- Math editor prototype working on a Microsoft Surface (Hands-On Math [2])


Development goals

• Make StarPad SDK work with our whiteboard
  • Support other touch / pen input devices
• Make it easier to use StarPad SDK functionality
  • Create own visualizations
  • Access parsed math expressions more easily
• Interaction Design
Application Design

Input Handling
Starpad Integration
Plugin Implementation

Diagram:
- Touchco
- Anoto
- Combined Input Driver
- Input Framework
  - pen/touch events
  - touch events
- Formula Editor Canvas
- StarPad SDK
- Formula Editor Application
- Plugin Manager
- Plugin Template
  - Plugin
  - Plugin
  - Plugin
Application Design

Input Handling

- Touchco
- Anoto

Combined Input Driver

Input Framework

Pen/touch events

Touch events

Formula Editor Canvas

Plugin Manager

StarPad SDK

Plugin Template

Formula Editor Application
Interpolating Force Sensitive Resistance (IFSR) Sensor\textsuperscript{[1]}

projection foil

IFSR foil

IFSR tracking data
screen space

projection foil

pen

touch

IFSR foil

IFSR tracking data

media interaction lab
24” IFSR Prototype

touch

pen
24” IFSR Prototype

touch

pen
ANOTO

<table>
<thead>
<tr>
<th>Anoto</th>
<th>IFSR</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Accuracy (680dpi)</td>
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**Combined driver + calibration**
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InputFramework
(DiamondTouch, Dell DevKit, NextWindow, TouchCo, TUIO, …)
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**InputFramework**

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**StarPad SDK**
Protoype with touch & pen input
Pressure as an Input Metaphor
Application Design

Starpad Integration

Diagram showing the integration of Touchco and Anoto with the Starpad SDK through a Combined Input Driver and Formula Editor Canvas.
SDK Integration

StarPad SDK
- Collection of tools to support ink applications
- Extends WPF Ink Canvas

NiCE Formula Editor
- Extends the StarPad Ink Canvas
- Creates Interface between the SDK and the plugin mechanism
Application Design

Plugin Implementation
Plugin system

- TemplatePlugin
  - Encapsulation/preprocessing of interaction
  - Template for own visualizations
- Plugin Manager
  - Input forwarding
  - Dynamic library loading
- Expression parsing
  - Translates StarPad MathExpressions into C# data types
Conclusion
So far...

- Input Handling
  - Integration of InputFramework
  - Successful tests on other hardware
- Plugin System
  - Easy access to input functionality
  - Easy access to math functionality
  - Several example plugins
- Interaction Design
  - Pen and touch interaction
  - Pressure interaction
What’s next?
Interaction techniques
Questions?

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