# Networked Digital Whiteboard with Handwritten-Symbol Interpreter and Dynamic-Display-Object Creator

Atsuhide Kobashi

Henry M. Gunn High School Palo Alto, California

September 2009

# What is it?

- Tcl/Tk-based whiteboard presentation tool with unique functionalities
  - Audience can participate in the presentation
  - Networked
  - Enables quick construction of complex objects for displaying during presentation

### **Motivation**

- Our situation
  - Educational presentation in classes and conferences
  - Scientific subjects: math, physics, chemistry, etc.
- Problems with the conventional presentation tools (PowerPoint, Impress, etc.)
  - One way information flow
  - Remote (off-site) audience cannot participate
  - Lack of tools to quickly create
    - Complex symbol structures
    - Dynamic display objects
- Solution: Our new application

### **New Function 1**

- Two way information flow
  - Enable audience to add objects on the screen
  - Types of objects to be dynamically created:
    - Text
    - Images
    - Lines, arrows
    - Rectangles, ovals
    - Widgets, both static and dynamically manipulable



- Communication through network with participants at both
  - Presentation site
  - Remote locations

## **Networked Two-Way Presentation**



#### **New Function 3**

 Capability to efficiently and quickly construct complex symbol structures (for math, logic, scientific symbols) by handwriting

#### **New Function 4**

• Capability to quickly create widgets including dynamically manipulable ones

### **Presentation Screen 1 (Original)**

- Tk-based window
- No full-screen mode



#### **Presentation Screen 2** (Augmented by participant)

• Text and arrow added by a participant



#### **Presentation Screen 3** (Augmented by participants)

• Canvas window with scrollbars added by another participant



#### **Presentation Screen 4** (Augmented by participants)

- Spinbox added by the participant who created the canvas window
- Spinbox linked to a variable that affects the output (quadratic curve) on the added canvas



#### **Presentation Screen 5** (Augmented by participants)

• Text widget window with a scrollbar added by another participant



#### **Master Controller**

- Used by the presenter
- Client side controller has no page-change capability

Master Contr	roller – + X				
Communication					
Andy: I want to add more comments.: Presenter: Write just below Figure 2.	< 1 × >				
Andy: Can I paste an image, too?	Send Update Clients				
Write Message	Participants				
Sure. Max width of the image	Chris				
must be 800 pixels.	Andy				
	Cathy				
	Morgan				
	Z Z				

#### **Draw/Write Tool**



• Used for all drawing and writing including the handwriting of symbols

### **Hand-Written Symbol Interpreter**

- Invoked by the Draw/Write tool
- Size and color set by the Draw/Write tool
- Location set by mouse click on the target plane



## **Widget Creator**

- Three types of widgets
- Contents selector helps quick composition
- Spinbox can be linked to a variable that changes output

🔲 Wi	dget Crea	tor	- + *
Туре	○ Text ● Canvas ○ Spinbo	x	
Dimension	200 € V 250 € H	/idth eight	
Scrollbars	☐ Horizon ☐ Vertical	tal	
Scroll Regio	n		
Color	Foregr Backg	ound round	
Contents	Quadratic 1 Quadratic 2 Differentiat Differentiat Integration	ion 1 ion 2 1	
		Width	
		Initial	Value
		Min Va	lue
Spinbox		Max V	alue
		Incren	nent
		Variab	le Name
		Target	ID
	Create	Send	Cancel

### **Canvas created by Widget Creator**

	C Text	📄 🛛 Widget Test Board 📃 🚸 🗙
Type	Canvas	
Type	⊂ Spinbox	
	250 € Width	Cathy 1
Dimension	250 🗣 Height	
Carollhara	🔽 Horizontal	B
Scrolibars	🔽 Vertical	$\overline{\Lambda}$
Scroll Region	n 0 0 600 600	
Color	Foreground Background	
Contents	Quadratic 1 Quadratic 2 Differentiation 1 Differentiation 2 Integration 1	
Collectory.	Width Initial Value Min Value	
Spinbox		
	Variable Name	
	Target ID	

## **Spinbox created by Widget Creator**

	O Text	
Туре	🗇 Canva	5
	<ul> <li>Spinbe</li> </ul>	ox
Dimension	250 🛢	Width
Differision	250 🛢 I	Height
Scrollbars	Horizor	ntal
s ues a	Vertica	al
Scroll Regio	n	
Wi Type Dimension Scrollbars Scroll Regio Color Contents Spinbox	Foreg	ground
	Back	ground
	Quadratic	1
Contents	Differentia	tion 1
	Differentia	ition 2
	Integratio	n 1 📈
Scroll Region Color Contents	12	Width
	5.5	Initial Value
	-50	Min Value
Spinbox	50	Max Value
	0.1	Increment
	n Iout - T	Variable Name
	Cathy 1	larget ID
	Create	Send Cancel

#### **Details on the Three Functions**

- Networking
- Handwritten symbol interpreter
- GUI and Widget Creator

### **Behind the Networking**

- Use of TCL's network-related commands only
  - Easy to develop
- Use of custom header to indicate
  - Types of data (multiple combinations)
  - Length of each type
  - How to handle each segment
  - Owner ID and sequence index
  - Optional extra information field
- Economy on transmitted data
  - Use of wish by both server and clients reduces the amount of transmitted code (suitable for networking)
  - For the widgets created by the Widget Creator, only the specifications entered in the Widget Creator are transmitted

## **Behind the Hand-Written-Symbol Interpreter**

- Many algorithms available
- No perfect or even near human level
- Requires lots of CPU power
- Use of C module needed for speed
- Still under development and modules for a small number of symbols developed
- Font for the converted results
  - Outputs from Tex used
  - For the symbols not available from Tex, custom raster symbol creation required

## **Behind the GUI and Widget Creator**

- All GUI Tk-based.
- Merits of Tk
  - Easy and quick to create GUI
  - Small amount of code fits well for transmission
  - Easy to inspect the transmitted code in development stage, since it is written in human readable script.
- Safe independent operation for each participant guaranteed by multiple interpreters

### **Current Problems**

- Overall slide creation process
   Takes more time to make presentation pages than the conventional presentation tools
- Graphic input tools
   More variation needed
- Widget creator Wider variety of widgets need to be handled
- Multiple interpreter design
  - Use of threaded system desirable for smooth operation
- Hand-written symbol interpreter
   Coverage of more symbols and better recognition algorithm needed
- Other functionalities
  - Page advance/backup capability on the client side without affecting the display of the server

#### Conclusion

- Current state still version 0.1
  - Rough edges exist. Refinement needed.
- Currently TCL/TK knowledge required to compose presentation slides. (Less so for clients to add objects.)
  - More convenience modules needed to compete directly with PowerPoint and Impress.
- High potential to become a useful tool for users in various fields, not just education.
  - No other tool can enable networked two-way interactive presentation with dynamically manipulable objects.