

Ink, Touch, and Windows Presentation Foundation

Lecture #4: Ink and WPF
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From Last Time

- Windows Presentation Foundation (WPF)
 - integration of
 - Ink
 - multi-touch
 - 2D Graphics
 - 3D Graphics
 - video and audio
 - uses visual tree model
 - component based
- XAML and C# code
- Important control – *InkCanvas*

Important Ink Components

- InkCanvas – System.Windows.Controls
 - receives and displays ink strokes
 - starting point for ink applications
 - stores ink in Strokes
- System.Windows.Ink Namespace
 - contains classes to interact with and manipulate ink
 - examples
 - Stroke
 - InkRecognizer
 - InkAnalyzer
 - GestureRecognizer

Dealing with InkCanvas

- *InkCanvas* collects Strokes
- Strokes contain *StylusPoints*
- *StylusPoints* contain X,Y, Pressure
 - can also be converted into Geometry objects
- Strokes contain
 - digitizer packets
 - drawing attributes
 - application-defined data
- *InkCanvas* has several stylus level events
 - *StrokeCollected*, *StylusInAirMove*, ...

Strokes and Geometry

- Strokes
 - perform hit tests
 - get geometry, bounds, Bezier points
 - add properties
 - transformations
- Geometry
 - lose pressure and stylus specific data
 - Within scope of 2D graphics API
 - get area
 - create shapes
- No Cusp or self-intersection detection

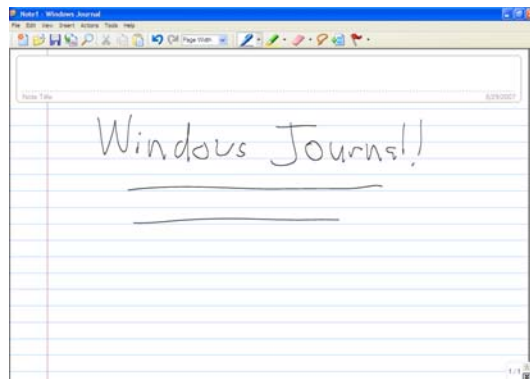
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More InkCanvas Features

- Enough support to implement Windows Journal
- Modes
 - Ink
 - InkandGesture
 - GestureOnly
 - EraseByStroke
 - EraseByPoint
 - Select
 - None



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Drawing Attributes

- Can access on stroke level using *Drawing Attributes* property
- Can access on global level using the *InkCanvas DefaultDrawingAttributes* property
- Example attributes
 - color
 - Bezier curves
 - height and width of ink stroke
 - ignoring pressure

InkCanvas Example

```
<Window x:Class="WpfApplication4.InkTest"
  xmlns="http://schemas.microsoft.com/winfx/2006/xaml/presentation"
  xmlns:x="http://schemas.microsoft.com/winfx/2006/xaml"
  Title="InkTest" Height="300" Width="300"
  Visibility='Visible'>
  <Grid>
    <InkCanvas
      Name='_ink'
      StrokeCollected='Collected'
      Background='Beige' />
    <Canvas Name='_overlay' />
  </Grid>
</Window>
```

```
private void Collected(object sender, InkCanvasStrokeCollectedEventArgs e)
{
  _overlay.Children.Clear();
  Brush fill = new SolidColorBrush(Color.FromArgb(120, 255, 0, 0));
  foreach (StylusPoint pt in e.Stroke.StylusPoints)
  {
    double markerSize = pt.PressureFactor * 35.0;
    Ellipse marker = new Ellipse();
    Canvas.SetLeft(marker, pt.X - markerSize / 2);
    Canvas.SetTop(marker, pt.Y - markerSize / 2);
    marker.Width = marker.Height = markerSize;
    marker.Fill = fill;
    _overlay.Children.Add(marker);
  }
}
```

Examples adapted from *Essential Windows Presentation Foundation* by Chris Anderson, Addison Wesley, 2007.

Creating Your Own InkCanvas

- InkCanvas handles approx. 90-95% of what you need
- Can develop custom InkCanvas
 - InkPresenter – System.Windows.Controls
 - DynamicRenderer – System.Windows.Input.StylusPlugins
 - Stylus events
- See Windows SDK documentation

Stylus Descriptions

- Other data besides x,y points and pressure
 - xtilt, ytilt
 - Barrel button
- Can request data globally using *DefaultStylusPointDescription* on *InkCanvas*
- Per stroke with *Reformat* method on *StylusPointCollection*

Stylus Description Example

```
public InkTest() {
    InitializeComponent();
    _ink.DefaultStylusPointDescription = new StylusPointDescription(
        new StylusPointPropertyInfo[] {
            new StylusPointPropertyInfo(StylusPointProperties.X),
            new StylusPointPropertyInfo(StylusPointProperties.Y),
            new StylusPointPropertyInfo(StylusPointProperties.NormalPressure),
            new StylusPointPropertyInfo(StylusPointProperties.BarrelButton), });
}
```

Asks for information on x,y, pressure, and if the barrel button is pressed.

Gesture Recognition

- Built in Gesture recognition engine
 - handwriting recognition and ink analysis are separate (outside of InkCanvas)
- 41 distinct gestures (found in ApplicationGesture enum)
 - check
 - square
 - triangle
 - arrows
 - scratchout
 - etc...

Gesture Recognition Example

```
<Window x:Class="WpfApplication6.Window1"
xmlns="http://schemas.microsoft.com/winfx/2006/xaml/presentation"
xmlns:x="http://schemas.microsoft.com/winfx/2006/xaml"
Title="GestureTester">
<StackPanel>
    <InkCanvas Height='200' Name='_ink'
        Gesture='InkGesture'
        EditingMode='InkAndGesture' />
    <ListBox Name='_seen' />
</StackPanel>
</Window>
```

```
public partial class Window1 : Window {
    public Window1() {
        InitializeComponent();
        _ink.SetEnabledGestures(new ApplicationGesture[] {
            ApplicationGesture.AllGestures,});
    }

    private void InkGesture(object sender, InkCanvasGestureEventArgs e) {
        _seen.Items.Add(e.GetGestureRecognitionResults()[0].ApplicationGesture);
    }
}
```

Collecting Timing Information

```
// Create a guid for the date/timestamp.
Guid dtGuid = new Guid("03457307-3475-3450-3035-640435034540");
DateTime now = DateTime.Now;

// Check whether the property is already saved
if (thisStroke.ContainsPropertyData(dtGuid)) {
    // Check whether the existing property matches the current date/timestamp
    DateTime oldDT = (DateTime)thisStroke.GetPropertyData(dtGuid);
    if (oldDT != now) {
        // Update the current date and time
        thisStroke.AddPropertyData(dtGuid, now);
    }
}
```

This snippet works on a Stroke by Stroke basis. Can you think of how to do this on a point by point basis?

Multi-Touch in WPF 4

- Basic Touch events
 - *TouchEnter, TouchLeave*
 - *TouchMove, PreviewTouchMove*
 - *TouchDown, TouchUp*
- Events get raised for each finger independently
- Equivalent mouse events for first finger

Multi-Touch in WPF 4

- Manipulation events
 - *ManipulationStarting*
 - *ManipulationDelta*
 - *ManipulationCompleted*
- Operations
 - Translation
 - Scale
 - Rotation
 - Expansion
- Supports inertia

Assignments

- Readings
 - WPF Unleashed -- Chapters 9-11, 15-18
 - Windows SDK documentation
 - Windows.System.Control.InkCanvas
 - Windows.System.Input.Stylus
- Assignment 1 – MiniJournal posted soon