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*

Ink Environment Choices

- Microsoft traditional dev stream: Visual Studio, C#, WPF or (Mono+Xamarin)
  - ***Pros***: *Mature platform with many online resources*
  - ***Cons***: *Can be deployed only on Windows ecosystem*
  - *Using Mono+Xamarin can be deployed cross-platform*
- Microsoft new dev stream: Visual Studio, JavaScript(or Typescript),HTML
  - ***Pros:*** *Can be deployed cross-platform(windows, android or IOS)*
  - ***Cons:*** *Relatively new computing environment with new API*
- Other alternatives, such as Python/Kivy, IOS, Android.
  - ***Pros:*** *Open-source with many online collaboration.*
  - ***Cons:*** *Have little support on inking*

Traditional Ink and Touch Ink SDK

Before Windows 8.1:

- The inking API is *System.Windows.Ink*
- Online Sample code: *Adventures into Ink API using WPF*

After Windows 8.1:

- The inking API is *Windows.UI.Input.Inking*
- Online Sample code: *Input:Simplied ink sample*

- You can find more articles or sample code resources from Microsoft *Windows Dev Center or Code project*

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
    - GestureRecognizer
  - InkAnalyzer now separate (only on 32 bit)
    - needs IACore.dll, IAWinFX.dll and IALoader.dll

Dealing with InkCanvas

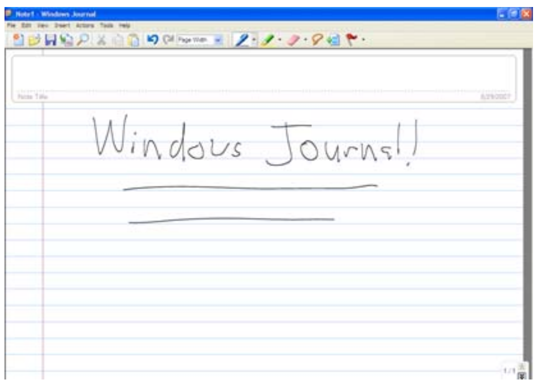
- *InkCanvas* collects Strokes
- Strokes contain *StylusPoints*
- *StylusPoints* contain X,Y, Pressure
  - can also be converted into Geometry objects
- Strokes contain
  - digitizer packets
  - drawing attributes
  - application-defined data
- *InkCanvas* has several stylus level events
  - *StrokeCollected,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

More InkCanvas Features

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



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);
  }
}
```

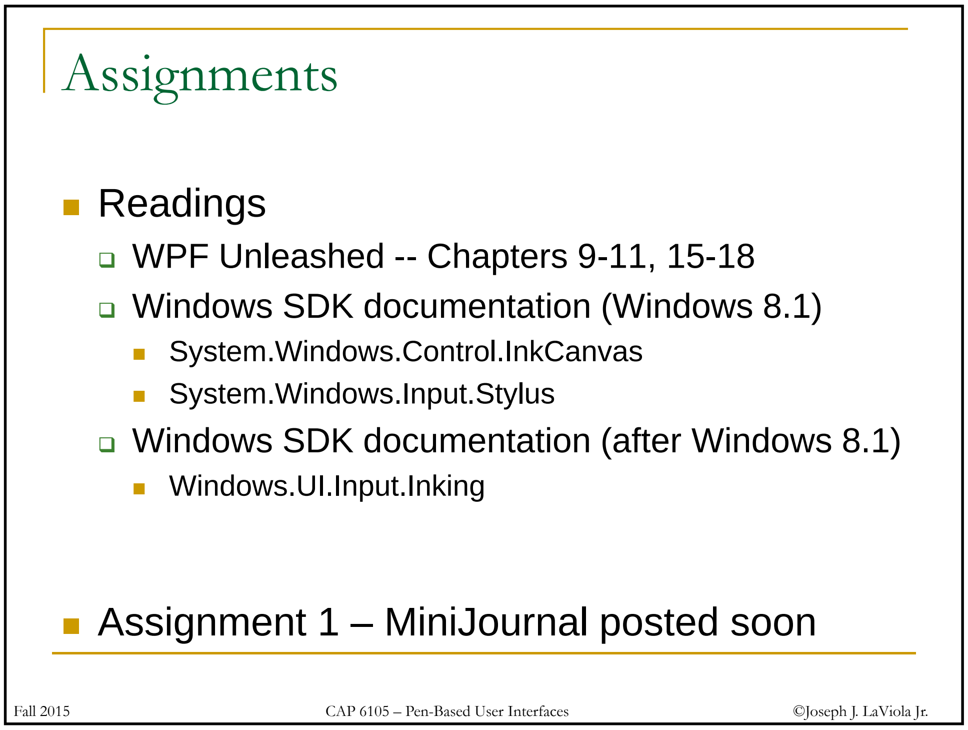
This snippet works on a Stroke by Stroke basis. Can you think of how to do this on a point by point basis?

Multi-Touch in WPF 4.5

- 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 4.5

- 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 8.1)
    - System.Windows.Control.InkCanvas
    - System.Windows.Input.Stylus
  - Windows SDK documentation (after Windows 8.1)
    - Windows.UI.Input.Inking
- Assignment 1 – MiniJournal posted soon