

A Framework for Developing Multitouch Applications to Enhance K-12 Education

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Abstract:

Multitouch platforms offer new and exciting ways of interacting with computers. Traditional input devices, such as the mouse or keyboard, only allow input from one user at a time. However, multitouch gestures allow for multiple inputs and often resemble physical interactions that are more natural and intuitive for users. Additionally, large multitouch interfaces allow more than one person to collaborate on the same screen easily. This encourages people to work together and communicate. Multitouch applications have the potential for offering a new hands-on approach to learning. Their interactive nature is engaging and appeals to a wide variety of learning styles, and the use of large interactive multitouch screens encourages collaboration. Science and math education, in particular, can benefit from the highly interactive nature of multitouch technology. With access to a multitouch computer and applications, students can work together to learn concepts and solve problems.

Because of the positive affect that interactive learning can have on students, teachers from different backgrounds need to have access to multitouch technology. The goal of this project is to give educators the ability to leverage multitouch technology in their classrooms. The solution that was developed will allow users to create multitouch presentations using images, video, text, and sound. These presentations will allow basic gestures, including zoom, rotate, and pan. A Creator program will allow teachers to develop the presentations on any computer running Windows XP or higher. After the presentation is completed, a Viewer program will run the presentation on a multitouch enabled computer running Windows 7 and process incoming touch information. This toolset has been developed with accessibility and affordability in mind.

This application toolset was developed by a team of undergraduate students. It is written in C# and makes use of the Windows Presentation Foundation and Windows Touch API. A demonstration will be included with the presentation. This project is supported by the Computing Research Association's Status of Women in Computing Research, the NASA Space Grant, and the South Dakota School of Mines and Technology.

Introduction

The Blob Multitouch Designer is an effort to bring emerging multitouch technology into K-12 classrooms. It allows teachers to create interactive presentations that encourage collaboration between students. The interactive presentations use images, text, video, and audio. Using different types of media encourages students with many learning styles to participate. The images, text, and video appeal to visual learners. Auditory learners will appreciate the audio clips and video as well. The hands-on nature of the Multitouch hardware engages kinesthetic learners. Finally, by bringing exciting technology into classrooms, children and teenagers are inspired to pursue further education in math and science.

The framework consists of three applications. First, the Designer allows teachers to create presentations from a regular desktop computer. These presentations can then be loaded into the Viewer program that is installed on the multitouch system. The third application is a demo program that can be used in the classroom or as a tutorial for the teachers creating the presentations.

Blob Multitouch Creator

User Interface

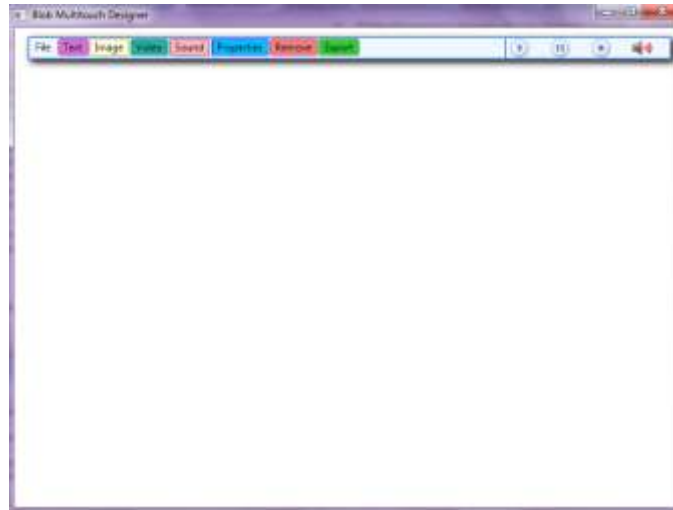


Figure 1: Creator Interface

The Blob Multitouch Creator is the first part of the Blob Multitouch Designer. Teachers use the Creator program to design Multitouch presentations for their students. Presentations consist of images, videos, audio, and text. The user interface is shown above in Figure 1. The user interface has a clear, unobtrusive menu bar at the top which easily allows teachers to choose the multimedia element to be added. The playback control for audio and video is also located on the menu bar. Each button on the menu bar is defined below.

File: Users can select to start a new scene, load an existing scene, or close the program.

Text: This allows text to be added to the workspace. The font type, size, and color can be selected.

Image: The user can select an image to add to the workspace.

Video: The user can select a video to add to the workspace.

Sound: The user can select a sound file to play in the background of the presentation.

Properties: The user can change the properties of an existing object in the scene. The properties include height, width, and allowable gestures.

Remove: Removes an element from the workspace.

Export: Saves the presentation in a format recognizable by the Viewer program.

Features and Functionality

The main function of the Creator program is to prepare presentations for the Viewer. When images, video, and text are added a number of properties can be specified. The filename can be chosen via the Browse button. *Height* and *Width* are specified from the dialog box. *Movement*, *Rotation*, and *Scaling* refer to the gestures that will be allowable to this object in the Viewer. If none are selected, the object will be static. *Links*

To will connect an object to another scene when that object is clicked. A XAML file is chosen for this with the Browse button. The dialog box to add text has an additional feature that allows the user to change the font style and size of the text.

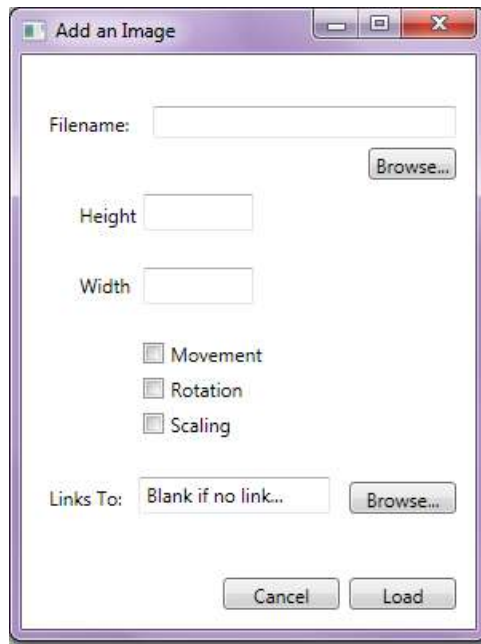


Figure 2: Adding an Image to a Scene

Underlying Technology

The Blob Multitouch Creator uses C# with WPF. This increases its compatibility with the Viewer program. WPF accommodates a wide variety of layout styles and incorporates multimedia. Using WPF made it easy to allow images, video, and sound into presentations.

The file is exported from the Creator in XAML format. The XAML format is necessary for the Viewer to use WPF and the Touch libraries. The Export feature of the Creator program also copies the multimedia files to a resources folder. This makes the presentation more portable and increases its ease of use. While Windows 7 is necessary for the Viewer program, the Creator program can run on any PC with Windows XP or higher. This allows a greater deal of portability so that teachers can make a presentation without the Multitouch hardware from work or home.

Multitouch Viewer

Overview:

The Viewer was developed in Microsoft Visual Studio 2010 using C#, .NET 4.0 and the Windows Presentation Foundation. It uses the TouchUp event to handle clicks and the Manipulation class available in .NET 4.0 to handle the panning, zoom and rotate transformations that happen when a user interacts with the scene. It runs on multitouch-enabled hardware running Windows 7 and imports scenes exported from the Creator to display them. It is made up of two main components, a graphical user interface and a scene loader.

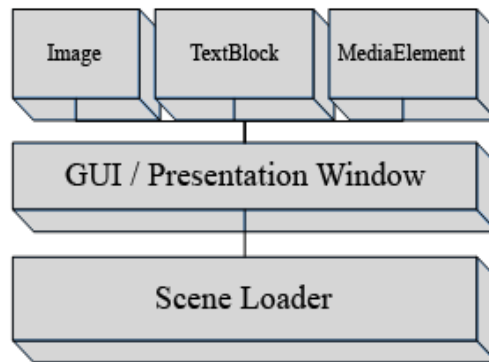


Figure 3: Viewer Structure

Graphical User Interface

The graphical user interface displays a container for the loaded scene as well as an Import Presentation button, gesture icons and a play/stop button for any audio that may be in the scene. Gesture icons display when the user is interacting with an object in the scene to visually show the gestures that are allowed for that object.

Scene Loader

The scene loader is responsible for importing a XAML file that was exported by the Creator. It loads the file and displays it in the presentation window. It also parses through the file looking for information about the gestures assigned to each object, and attaches the appropriate event handlers. Finally, it copies the associated scenes, images, video and text to a temporary location for easy access by the Viewer.

Supported Objects and Gestures

The Viewer supports all the objects and gestures that can be exported by the Creator. Supported objects include images, video, text, and sound. These objects are listed in a XAML file which must follow the expected format to display properly. Supported gestures include drag, zoom, rotate, or any combination of these. A click action is also supported, and this will load a specified scene into the Viewer on click.

Handling Events for Gestures

The Manipulation class includes several event handlers that can be programmed to handle multitouch manipulations including Rotate, Scale, Translate, TranslateX, TranslateY or all of the above. The two events used by the viewer include the ManipulationStartingEvent and ManipulationDeltaEvent. The possible gesture types are specified in the ManipulationStartingEvent. The Viewer application allows up to three different gesture types per object. Specific actions to take while these manipulations are being registered are covered in the ManipulationDeltaEvent. Any object that will be using the manipulation events must have the IsManipulationEnabled event set to true.

The Viewer also supports the TouchUpEvent on objects that need to register a click and load a new scene into the Viewer. The scene file location is saved in a hidden TextBox field that follows the naming convention. When the Viewer program finds an object that is clickable in the XAML file it searches for its associated text field to get the scene location. When a user touches the clickable object, the Viewer proceeds to load the new scene and display it.

Assigning Events to Dynamically Loaded XAML

XAML that is dynamically loaded into an application cannot have event handlers associated with it, so an alternative method of attaching events for gestures had to be developed. It was decided to use a naming convention for objects in the scene. The naming convention would specify the types of gestures allowed for that object. The table below summarizes the expected naming scheme. The ObjectName can be any descriptive name for the object and the OptionsAllowed must be one of the values in the table.

Example Object Name: [ObjectName]_[OptionsAllowed]

OptionsAllowed	Description	Constraints
All	All gestures are allowed for the object.	None
Translate	Drag gesture is allowed for the object.	None
Scale	Zoom gesture is allowed for the object.	None
Rotate	Rotate gesture is allowed for the object.	None
RotateTranslate	Rotate and Drag gestures are allowed for the object.	None
Rotate Scale	Rotate and Zoom gestures are allowed for the object.	None

TranslateScale	Drag and Zoom gestures are allowed for the object.	None
Click	Clicking on the object will load a new scene	Must have an associated TextBox field.
Click_Scene	Contains the location of a scene to load when an associated object is clicked.	Must have an associated object with the Click option.

Table 1: Naming Conventions for Supporting Gestures in the Viewer

Once the scene loader has completed loading the file, the scene is displayed in the presentation window. Users will be able to interact with the objects in the scene as specified by the assigned gestures. If a video file was loaded, it will display in a StackPanel that includes play, pause, and stop buttons. If an audio file was loaded, a play button appears in the toolbar.

Demonstration

Now let's take a look at how the Creator and Viewer can be utilized in a complete presentation. For one's benefit, the framework includes a demonstration program on a Timeline of Women in Science. We will use this program to showcase the framework's capabilities.

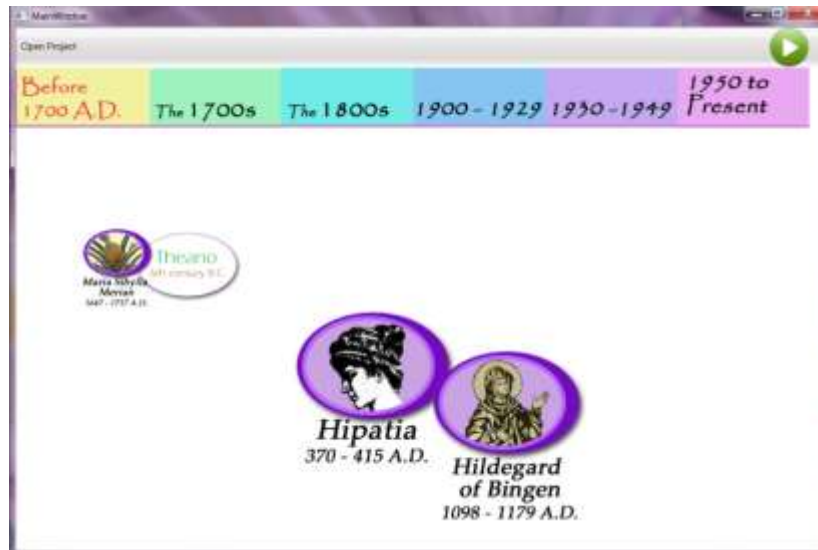


Figure 4: Timeline Opening Scene

First, the demo program is opened to its initial page. One can see a bar of different time

periods set across the top of the screen. The time period currently selected is before the 1700s. Below the bar is a selection of images referring to a specific scientist of the selected period, in this case, scientists who were born before the year 1700.



Figure 5: Specific Scientist's Scene

By touching the image of a specific scientist, that scientist's scene is brought up. The scene typically includes the image of the scientist, a small commentary about the scientist and her achievements, and occasionally an activity relating to the scientist's field of study.

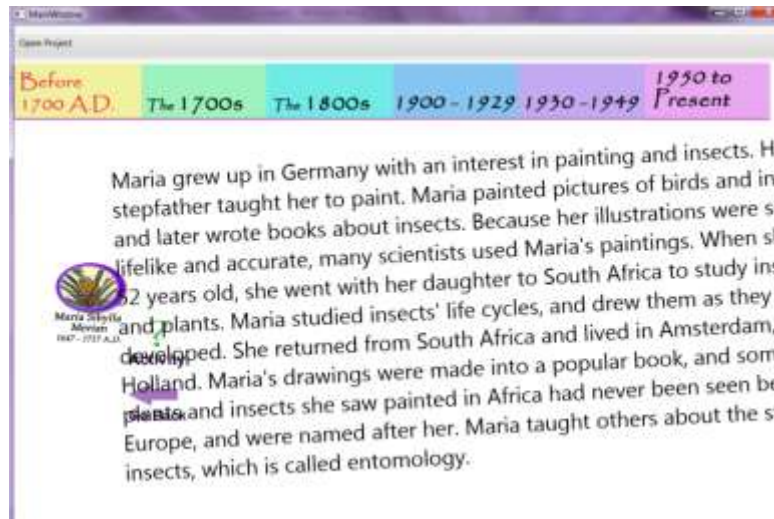


Figure 6: Interacting With a Scene

The text and image of the scientist's scene can be resized for the user's benefit. By touching the back button the scene of all the scientists born in that time period are redisplayed.

One can explore the other time periods by simply touching the respective time period on the timeline bar at the top of the screen.



Figure 7: More Scenes

As one can see, the user(s) can explore a wide variety of women scientist at one's own pace and in the order of one's choosing. By showcasing all these women scientists, girls are hopefully encouraged to pursue higher education and consider careers in science and technology.



Figure 8: Grace Hopper Scene

Benefits of Using Educational Multitouch Applications in the Classroom

Multitouch applications have other benefits as well. By utilizing touch, kinesthetic learners are more engaged in the program and thus the learning process. Visual learners benefit from the visual aspect of the presentations with its images, videos, and text. While auditory learners benefit from the videos and sounds added to the presentations. This means that the basic three learning styles are all engaged in the multitouch presentations.

Conclusion

In conclusion, the Blob Multitouch Designer is being developed to help educators encourage students, particularly girls in K-12 schools to consider careers and higher education in science and technology. It does this by giving the teachers the option to create multitouch interactive presentations that engage students and promote interest in learning. It consists of a Creator program which is used to build the presentations in a user-friendly way. A Viewer application is used to display the presentations on multitouch enabled hardware running Windows 7. Finally, a timeline of the history of women in science and technology was created as an example of the capabilities of the Blob Multitouch Designer.

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