FLARE: An Open Source Toolkit for Creating Expressive User Interfaces for Serious Games

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ABSTRACT

Recent years have seen a growing recognition of the transformative potential of games for education and training. Supporting the efficient creation of expressive user interface content that is both effective and engaging is critical to the serious game development process. To this end, this paper presents FLARE, an open source toolkit for creating expressive user interfaces. The toolkit leverages the authoring capabilities of Adobe Flash Professional, e.g., vector graphics, animation, text, and sound, while integrating seamlessly into the popular Unity cross-platform game engine. Our experience using FLARE suggests that it is an effective toolkit for developing expressive user interfaces for serious games.

Categories and Subject Descriptors

H.5.2 [**Information Interfaces and Presentation**]: User interfaces – *Graphical user interfaces (GUI), Prototyping*.

Keywords

User Interface, Serious Games, Content Development, Toolkit.

1. INTRODUCTION

Recent years have seen a growing interest in serious games, which leverage the motivational power of games to support learning. Serious games are under investigation in many domains including language learning [2] and conflict resolution [1]. A key challenge faced by serious game developers is efficient creation of *expressive user interfaces* that are highly dynamic and interactive, as well as effective and engaging. Creating user interfaces offering rich immersive experiences that simultaneously reduce cognitive load and increase emotional impact has the potential to significantly improve game adoption [3]. However, without effective tools to support the creative process, developing expressive user interfaces is impractical. Developing a game's user interface is often a time-consuming iterative process involving designers, artists, and programmers [4]. Empowering designers and artists with tools that support rapid iteration promotes increased productivity and more extensive exploration of the user interface design space. Likewise, if these tools support content creation with limited (or no) programmer involvement, then programmers are free to focus on other technical aspects of the game.

This paper presents FLARE, an open source toolkit for creating expressive user interfaces with the Unity® cross-platform game engine. Leveraging the authoring capabilities of Adobe® Flash® Professional, a popular digital content creation tool, FLARE provides artists with the ability to rapidly iterate on user interfaces. We provide an overview of FLARE's architecture and illustrate its use in two serious games.

2. FLARE

FLARE is a general-purpose toolkit for creating expressive user interfaces. At its most basic level, FLARE can be viewed as a Unity plugin for loading, manipulating, and rendering files conforming to the Adobe Flash SWF file format. A SWF file includes definitions of graphical shapes, sounds, and text, referred to as *display objects*, as well as a series of frames that specify animations involving the display objects. Fundamental to FLARE's operation is the *display list*, which is a runtime hierarchy of display objects. The display list is updated through *timeline actions* (e.g., adding objects, transforming objects) contained in SWF files as well as programmatically through code. The FLARE architecture consists of three main components: an API for loading and manipulating SWF content, a custom Unity component for rendering SWF content as a camera overlay, and a custom Unity asset importer allowing easy incorporation of SWF files into Unity projects.

2.1 Class Hierarchy

FLARE includes an API implemented entirely in C# that supports the loading, manipulation, and rendering of SWF content in Unity. Because the API is modeled after Adobe's ActionScript 3.0 class hierarchy, FLARE eases the transition for Adobe Flash developers who wish to create user interfaces in Unity. A class diagram of FLARE's core classes is shown in Figure 1.
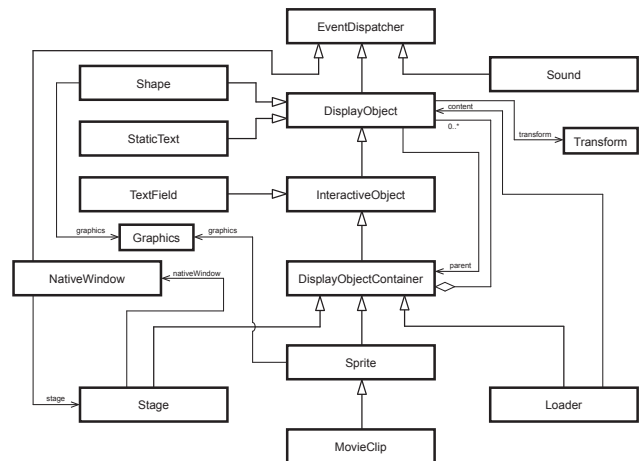

Figure 1. Class diagram of FLARE's core classes.

2.2 Camera Overlay

The Unity game engine utilizes a component-based architecture to support creating game objects with complex behaviors. FLARE includes a custom Unity component that can be attached to cameras in the Unity editor, `SwfCameraOverlayPlayer`. This component enables cameras to render SWF content as an overlay providing developers with the ability to rapidly create user interfaces rendered on top of the 3D game world.

2.3 Importer

The Unity editor features an extensible asset pipeline that allows new asset types to be incorporated in Unity projects. FLARE extends Unity's asset pipeline to recognize SWF files by their ".swf" filename extension. Whenever a SWF file is saved in the Unity project's asset folder, the SWF importer creates (or updates) the corresponding SWF asset, which is an instance of the `SwfAsset` class. Within the Unity editor, SWF assets can be dragged onto `SwfAsset` references in the Unity inspector which provides a programming-free approach to associating SWF assets with the components that reference them.

3. EXAMPLES OF USE

To illustrate how FLARE enables the creation of expressive user interfaces, we describe its use in two serious games.

3.1 ENGAGE

ENGAGE is a serious game for middle school students with the goal of enhancing computational thinking and broadening participation in computer science (Figure 2). The development team faced two key challenges in creating ENGAGE's user interface: 1) developing aesthetically pleasing user interface components—such as menus, dialogue interaction, and visual programming capabilities—that harmonize well with the 3D game world, and 2) creating an intuitive user interface for some rather complex tasks (e.g., writing a program).
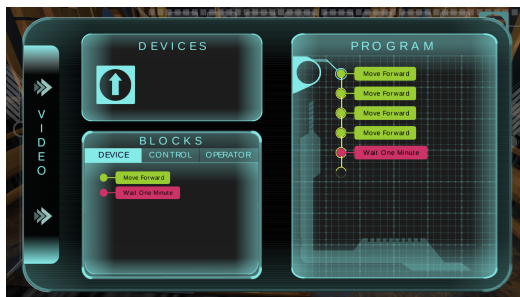

Figure 2. FLARE rendering ENGAGE programming interface.

We addressed both of these challenges with FLARE. Using Adobe Flash Professional as the user interface content development tool, the design team had great flexibility in creating high-quality visuals and interactions for the user interface. FLARE's SWF importer allowed SWF files to be easily incorporated into the Unity project, while the FLARE API provided convenient interaction techniques, such as dragging and dropping items, to build up complex interactions for the user interface.

3.2 CRYSTAL ISLAND

CRYSTAL ISLAND is a serious game for middle school science and literacy education featuring a science mystery where players attempt to discover the identity and source of an infectious disease. As the story unfolds, students find scraps of paper containing notes about the illness. Finding the notes are

significant events, so FLARE is used to display a visual flourish to reward students as shown in Figure 3.

Figure 3. FLARE-based reward animation in CRYSTAL ISLAND.

The flourish is composed of multiple 2D scale and transform animations that are played in synchronization with a fast tempo audio track. Implementing this type of animated sequence without FLARE would require a programmer to invest considerable time to develop and refine the timing of the animation. Using FLARE, a digital artist created and refined the animation using Adobe Flash Professional. Another advantage of using FLARE is the compact storage of complex animations it supports, which is important due to limited bandwidth in many public schools. The flourish SWF, which includes both the graphics and audio, is only 2.5MB in size.

4. CONCLUSION

Providing tools that support the creation of expressive user interfaces has the potential to significantly improve both the user interface development process as well as the end-user experience of serious games. With FLARE, designers, artists, and programmers are empowered to create user interfaces with an efficiency and expressive capability that until now has been impossible for many serious game developers using Unity. Our experience using FLARE suggests it is an effective toolkit for developing expressive user interfaces.

FLARE is an open source project. The project's website is located at http://flare.codeplex.com where the toolkit, source code, and documentation are freely available to the community.

5. ACKNOWLEDGMENTS

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