
A Platform for Creating Stories Across Digital and Physical Boundaries

Micah Eckhardt

MIT Media Lab
75 Amherst St.
Cambridge, MA 02142, USA
micahrye@media.mit.edu

Craig Ferguson

MIT Media Lab
75 Amherst St.
Cambridge, MA 02142, USA
fergusoc@media.mit.edu

Rosalind W. Picard

MIT Media Lab
75 Amherst St.
Cambridge, MA 02142, USA
picard@media.mit.edu

Abstract

This work presents a platform for story creation that allows for the extension of digital stories into physical objects and environments. The story platform is designed to allow for story authoring and interaction across digital and physical boundaries. We explore the platforms use in an educational setting with 12 students aged 11-17 years.

Author Keywords

Stories; Platform; Sensor Network; Tangible

ACM Classification Keywords

H.5.m. Information interfaces and presentation

General Terms

Design, Experimentation, Human Factors

Introduction

Stories are a part of every culture and time, whether charcoal drawings in caves or virtual reality games, stories are used to share information, teach and entertain people. With the increased presence of digital devices in our lives we are seeing a steady shift in the presentation of stories to digital devices. This trend started in mass with the Kindle ebook reader. The explosion of smartphones and tablet computers (mobile devices), over the last four years has quickened this transition. This is especially true over the last two years

with respect to interactive children's books and illustrated narratives.

The proliferation of mobile devices has resulted in a significant increase in interactive illustrated stories. Unlike the original Kindle, mobile devices allow for rich interaction through touch and other modalities, which can create dynamic interactions between a reader and a story. While there are many benefits of digital media and interaction, there is something special about physical objects and stories connected to places. Stories linked to objects and places are powerful, and tangible objects can facilitate learning and understanding [5], especially for young learners.

In this work we present a digital-to-physical-to-digital (DPD) interactive illustrated story platform, capable of creating stories and story interaction across digital and physical boundaries. We explore the platforms use with 12 children aged 11-17 years.

Related Work

Unlike traditional stories, interactive illustrated stories require computer programming to create animations and respond to user input. This requirement results in few people being able to create such stories. As a result, a growing number of people are exploring the development of authoring tools for interactive stores that simplify creation.

Carbonaro et. al build off of a commercially available game story construction tool, Aurora, to reduce the need for programming [2]. The authors note that a major obstacle to using most commercial tools for interactive story creation is the level of programming experience required to create the stories. While their

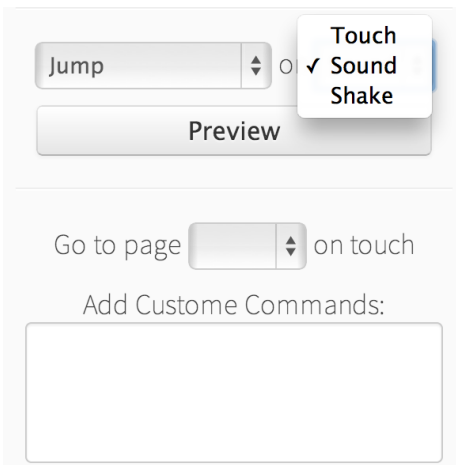
approach with ScriptEase helps simplify the programming, it is still programing oriented.

StroyTec

StoryTec is a story authoring tool that reduces the need for programing story interactivity [4]. While Carbonaro et. al simplify story creation with their ScriptEase approach, StoryTec allows for full graphical manipulation of certain story elements. StoryTec is focused on creating non-linear stories, the StoryTec GUI represents the flow of the story as a story graph. Story graph connections can be dragged between nodes to create non-linear stories, and complex decision paths.

In addition to the above works, there is a growing number of commercial tools targeting children's book authors and publishers. Notable examples are PlayTales [7] and Demibooks [3]. Both companies have desktop applications that allow for the creation of simple animation and story interaction through a GUI, requiring no programming. These tools are gaining in popularity for authors, as they open up the potentials of interactive stories to non-technical persons.

While there are a number of examples of interactive story authoring tools that target mobile devices, none of the approaches leverage any input other than touch. This is peculiar given the many sensors on mobile devices and the potential for creating novel interactions with them. In addition, we know of now story authoring tool that connects the digital story to physical objects and locations. While the potentials of such connections may not be obvious we already see the exploration of such creativity with Skylanders [8] and Disney's Infinity video games [9].



Drop down menus in story authoring tool allow for assignment of animation to image along with selection of which sensor input will trigger the animation. A text entry "Custom Commands" allows for entry of IOIO and NFC specific information.

Story Platform Overview

The DPD story platform builds off of prior work and extends it in novel ways. While greatly simplifying interactive story authoring, it also allows for the integration of physical objects into the storyline and story interaction.

The DPD story platform is comprised of four parts. The first is a web-based authoring tool and media library. The second is a mobile story reader (MSR). The third is a set of NFC tagged objects. The fourth is a bluetooth enabled hardware and sensor network using the IOIO board [1]. The entire system is integrated around the authoring tool and MSR.

Web-based Authoring and Media Library

The DPD story platform is designed to enable the construction of interactive, illustrated stories. Stories are intended for mobile devices. This focus on mobile devices, and their sensors, creates new opportunities for story interaction, and hence story creation (See Figure 1). The authoring tool is designed to simplify creation and requires no programming. Each scene of the story can be constructed by adding images to the story stage. The GUI allows for positioning, resizing, and layering of images. In addition, there are drop-down controls that allow the user to assign animations to images and to assign what input will trigger the animation. Inputs include touch, shake, sound, speech, location, NFC, hardware signals, and sensor signals. Furthermore, another drop-down menu allows the user to assign a "goto event" to any image, which results in the story going to any page in the story if the image is triggered. This allows the user to create non-linear stories or stories with specific decision paths.

Space Dragon

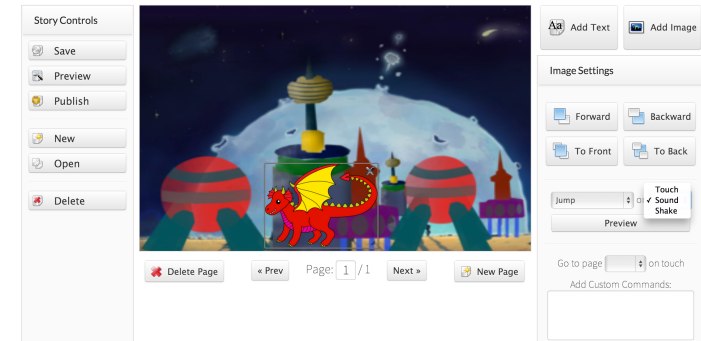


Figure 1. Web-based story authoring tool with completed scene.

Based on testing we found that the most difficult and time consuming aspect of story construction was creating artwork. While users can create their own artwork and upload it to the platform, we have also provided a public image library of 35,000 images. The image library is a modified version of the Openclipart project [6].

Mobile Story Reader

While primary story creation takes place through the web-based authoring tool all stories are intended for the MSR. The MSR is an Android based application that runs on smartphones and tablet computers. Within the extended context of digital and physical stories the MSR serves as the hub of all story interaction and control.

In addition to the MSR's ability to detect touch, motion, sound, speech, location, orientation, and light levels, the MSR uses Bluetooth to connect to distributed sensors and hardware. This ability to detect many

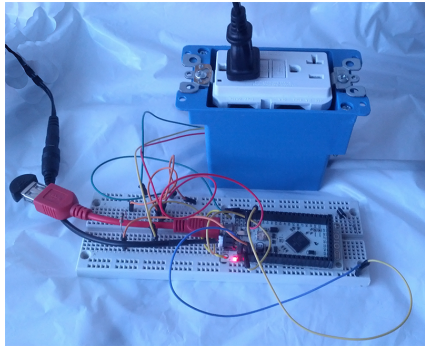


Figure 2. IOIO with relay circuit and wall outlet control.

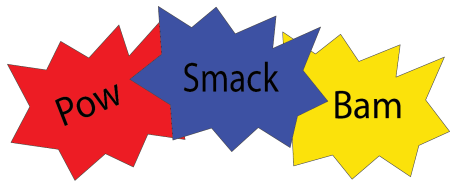


Figure 3. Batman story action props.

varied types of input and interaction distributed across the MSR and physical objects extend the story world beyond the digital screen and into the physical world.

NFC Objects

Most Android devices take advantage of Near Field Communication (NFC). NFC allows for the transfer of digital information between a NFC reader and a passive NFC tag.

We have developed a NFC writer, capable of writing data to passive NFC tags for the purpose of associating digital story content and controls to NFC tags. This allows us to embed a tag into any physical object with story specific information on it. The MSR is able to read these tags and respond dependent to the received information. Current responses include the placement of digital images, typically a digital representation of the physical object, into the story, or the changing of the story page.

Hardware and Sensor Network

Further integration of the story into the physical world is achieved by use of wireless hardware and sensors. We developed the MSR to leverage the IOIO electronics board, which allows for Bluetooth communication between the MSR and IOIO board. The board has 46 analog and digital I/O pins, allowing for a large number of hardware devices or sensors to be connected to the MSR. Currently, the authoring tool allows the user to select what pin is connected to what story scene element. We have limited the total possible pin uses to 4 digital outputs and 4 analog inputs for the time being.

Creating Stories Across Digital and Physical Mediums

The DPD story platform was used in a week long class with 12 students aged 11-17 years old. The students are part of a special school experience, which immerses them in technology, art, and design for a three month period. Prior to the DPD studio all students had completed several studio classes covering a number of technologies, including graphic design, robot building, and wearable computers.

The DPD studio was structured around creating stories across digital and physical mediums. Students worked in groups of 2 to 3 persons. Each group had to create a story that used digital and physical features. The following is a description of one groups story.

Creation of Batman Saves the Day

A group of 2 students worked together to create a story called "Batman Saves the Day." To begin the process the students created a storyboard. The storyboard described the visual elements of the story. Notes about interactivity where added to the storyboard scenes to describe how the user would interact with the story, and what story elements responded to user inputs. In addition the students wanted to explore the idea of a digital pop-out story.

To explore the digital-pop-out story idea we decided to create the story artwork using Autocad 3ds Max, 3D rendering software. This would allow any aspect of the story to be 3D printed, thereby popping out of the story. Once they had created the renderings they uploaded the images to the DPD for story construction.

Each scene of the story was constructed with the DPD authoring tool. Instead of relying solely animations for story interactivity, they developed a story interaction scenario that involved the reader activating a police siren and controlling a fight scenario between Batman and the Joker via physical props.

To implement their story interaction features they created a number of physical story props that were outfitted with NFC tags. each tag was encoded with information to tell the MSR what story scene to display. The physical props represented the fight action bubbles common in Batman comic books (See Figure 3). In addition, they 3D printed the Batman character from their story and outfitted it with an NFC tag that was used to bring the physical Batman character into the digital story.

To further explore the story experience across digital and physical mediums the students built a capacitive sensor and relay circuit to use with the IOIO board. The capacitive sensor was attached to a metal Mathbox police car and the relay circuit was integrated into a 115v wall outlet (See Figure 2). The desired effect, a flashing light, would be achieved when the police car is touched. After building the sensor and relay circuit they used the DPD authoring tool to indicate which story element responded to the analog input from the capacity sensor and what digital output pin should be activated on such a change.

Reading Experience of Batman Saves the Day

The reading experience of "Batman Saves the Day" starts out like any other interactive story. The user can touch different story elements to trigger animations and sounds, and story navigation is linear. When the

reader gets to the third page of the story interaction takes a twist. On this page the Joker has blown up a gas station and police have sped to the scene. On this page if the story reader touches the physical police car prop a bright desk lamp starts flashing on and off and the MSR reader plays a recording of a police siren.

At the next page the Joker stands atop a tall building and the people of Gotham are in desperate need of help from Batman, but the story will not proceed. The only way to continue the story is to bring the physical Batman prop into close proximity of the MSR. The Batman prop contains a NFC tag with a control signal that tells the MSR to continue the story at the appropriate page. When the page displays the digital representation of Batman is now part of the story.

The story continues as Batman tells the Joker that justice must prevail and a fight ensues. The fight sequence is controlled by the fight action props being brought into contact with the MSR. Each action prop takes the reader to a different scene of the fight. At last the fight ends and justice prevails when a second NFC tag on the Batman prop is brought close to the MSR.

Future Work

While all students were able to create unique stories that crossed digital and physical boundaries, there is still much to be learned about story creation and interaction across such boundaries.

Furthermore, while the DPD tools allowed for story creation, there are a number of shortcomings with the current system. The DPD tools simplify the process of creating interactive stories across digital and physical mediums, removing the need for any programming by the creator. This ease comes at a cost. The user is

limited to the predefined animations, and has limited input and output controls to the IOIO board.

While the story authoring tool allows for easy image layout, it lacks image editing feature. This results in the user needing to use other software for simple task such as rotating an image.

Although the authoring tool makes connecting inputs and outputs to the IOIO board easy, only those with a relatively strong understanding of electronics, hardware, and sensors can take advantage of this ease.

Acknowledgements

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Conclusion

In this paper we present the first DPD story platform. The DPD platform allows for the connection and extension of the story experience between digital and physical objects. The DPD platform opens up new opportunities for story creation that have not been easily achieved before. Much has yet to be learned about creating compelling stories across digital and physical boundaries, but now we can explore more easily.

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