Spin: A Photography Turntable System for Creating Animated Documentation

Tiffany Tseng
MIT Media Lab
75 Amherst St.
E14-445C
ttseng@mit.edu

ABSTRACT
While project documentation can help young Makers showcase their learning, prototyping skills, and creativity, motivating documentation practices has remained a challenge. Current tools for photographing projects are often disruptive to the flow of creating a design project, and compiling documentation into a readable and sharable format can be time consuming. To address these issues, I introduce Spin, a photography turntable system for creating animated documentation. Spin consists of a motorized turntable that pairs with a mobile device to capture 360-degree views of a DIY project at a particular point in time. These photographs are compiled into an animation of the project called a *spin*. As a project is developed over time, *spin* animations are compiled into a *set* animation showcasing the evolution of the project. This paper describes the motivation for creating the Spin system, its current implementation, and a planned pilot study involving introducing the system to several Makerspaces across the United States for extended use.

Categories and Subject Descriptors
K.3.1 [**Computers and Education**]: Computer Uses in Education

General Terms
Documentation, Design

Keywords
DIY, Maker, Portfolios, Reflection

1. INTRODUCTION
Of particular interest to the IDC community is the development of tools for young people to engage in creative expression. With increase efforts towards creating accessible hardware toolkits and digital fabrication tools, children are becoming empowered to create interactive, physical artifacts of their own design. These tools enable young "Makers" to explore powerful ideas ranging from computation, design, debugging, and prototyping.

As children engage in creative design processes, documentation is often seen as a critical element to capture their experiences and growth as designers, particularly in educational settings. However, the act of generating documentation remains a challenge. While camera-equipped mobile devices are becoming more ubiquitous, current workflows for creating documentation remain disruptive. Capturing ones process through photographs and videos often requires constant shifting between documenting and designing. Compiling this footage into a format that can be easily shared is an additional challenge. Motivating documentation practices thus requires making the documentation process more seamless and creating a documentation format that young people feel proud to share.

This paper introduces Spin, a photography turntable system developed to help designers, especially young Makers, capture engaging animations of their works-in-progress. With Spin, users can document the current state of their project in a 360-degree animation. The animation is created through the use of a motorized turntable that syncs with a mobile application to capture photographs of one's work [Figure 1]. The photographs are compiled into both animated videos and GIFs that can be shared on popular online communities such as Twitter and Facebook. Additionally, a web viewer enables users to explore and annotate their design process, encouraging reflection on how a design project comes together.

This paper describes the motivation for creating Spin, a technical description of its current implementation, and a future work plan for testing the turntables in Makerspaces where youth are building design projects.

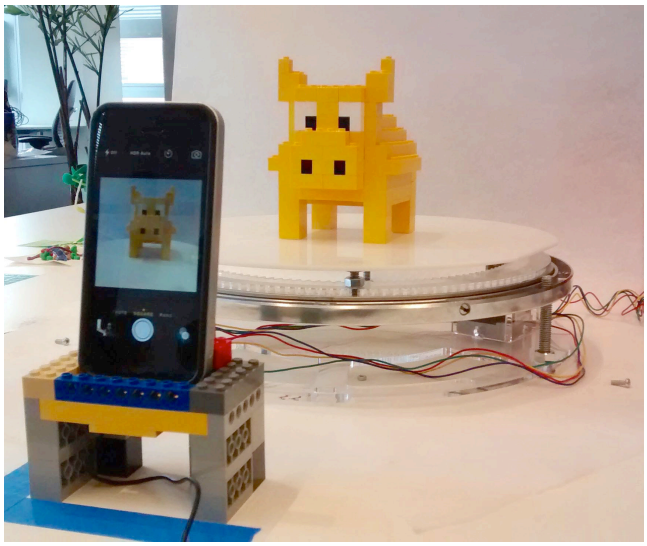

Figure 1: Spin Turntable and Mobile Application

IDC '15, June 21-25, 2015, Medford, MA, USA
ACM 978-1-4503-3590-4/15/06.

2. RELATED WORK

Current tools for young people sharing design projects including online communities like DIY.org [3] and Instructables [5], where users can share photographs and videos accompanied by text to describe their projects. On these platforms, Makers typically share finished work or instructions for others to create their designs.

While sharing a single image of a final product can reduce the barrier to sharing design work (a common practice on DIY.org), it can also be a limitation for users interested in sharing their design process. With a focus on instructional documentation, authors of Instructables often omit elements of their design process to create more efficient instructions [7]. Finally, Makers creating step-by-step documentation may also struggle with remembering to photograph their process and capture all the steps necessary for someone to replicate their design [7].

The online platform Build in Progress alternatively emphasizes a story-telling approach to documentation in which Makers share work-in-progress, describing the experiments that go into creating a project [2, 9]. Build in Progress focuses on visual representations of iteration rather than introducing new tools for seamlessly integrating documentation into the design process [8].

The Make Open Portfolios project highlights a tension between automated documentation tools and manual documentation [6]. While manual documentation can be disruptive, automated documentation tools may require significant post-processing to distill important elements of a design process. Finding a balance between automation and manual control can make the documentation process easier and thus make it more likely that young Makers will engage in documenting their learning.

Finally, animation platforms such as Sam Animation [4] and Pas a Pas [1] motivate youth through the creation of non-static media. The focus of both has been on students relaying their knowledge through constructing stop-animations from scratch. What might animation look like when applied to project documentation?

Spin explores how the use of a semi-automated turntable system can help reduce documentation efforts while generating engaging animated documentation. In the following section, I describe the current architecture of the Spin system.

3. SPIN SYSTEM

The Spin turntable system is comprised of three elements: a motorized turntable, a mobile application, and a web server and viewer [Figure 2]. It is designed to help users create animations of physical design projects at particular points in time (a *spin*) and compiles *spins* into a *set* that shows how a project evolves over time.

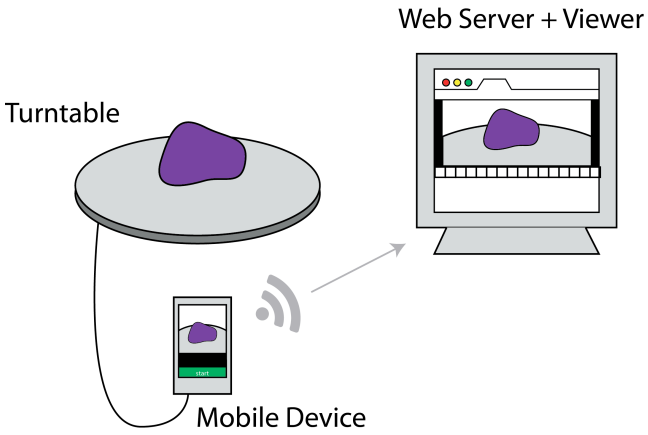

Figure 2: Spin system diagram

Rather than capturing every step that goes into creating a project, the Spin system is meant to capture the state of a project at the end of a work session. The user places the project on the turntable and physically connects their mobile device to the turntable via an audio cable. The system then proceeds to take a series of photographs of the project from 15 different angles, compiling these photographs into a 360-degree animation of the project (a video and GIF) that the user may share on various social networks. Spin is especially designed for projects that are created over the time span of several days, weeks, or months (rather than projects created over several hours).

3.1 Turntable

The Spin motorized turntable is programmed to rotate a full 360 degrees, stopping 15 times in a single revolution (or *spin*) to capture a 360-degree view of an object placed on the turntable – this process takes approximately 90 seconds to complete. The turntable components were chosen to be as accessible as possible. All components can be purchased from two key vendors, McMaster and Sparkfun, and all fasteners are obtainable at any standard hardware store.

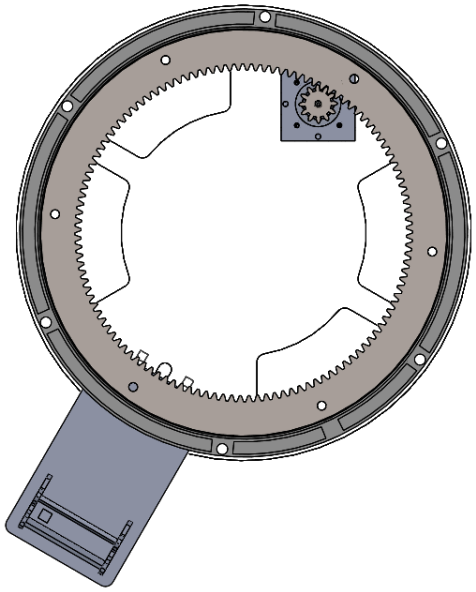

Figure 3: Top View of Turntable Assembly (without platform)

The turntable consists of a turntable bearing system (purchased), a stepper motor, laser-cut housing, and a 3D-printed coupling to connect the motor to the housing [Figure 3]. The stepper motor is connected to a microcontroller (Arduino) that is physically connected to an iOS device using an audio-jack connection.

3.2 Mobile Application

Spin incorporates an iOS application for capturing photographs of a project. Using the mobile application, the user can trigger the turntable to start, at which point the turntable automatically moves and syncs with the application to capture 15 photographs in 24-degree increments [Figure 4].

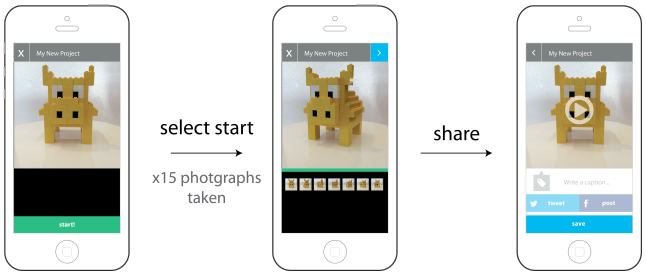

Figure 4: Spin Mobile Application interface

These photographs are uploaded to a server, which processes the images using the FFMPEG video-processing platform to return both an mp4 video and GIF animation of the spin. The images are compiled with a frame rate of 5 images per second, creating a short, 3-second long clip for each *spin* [Figure 5]. With this design, the user can start the turntable, walk away, and return to a generated animation of their project.

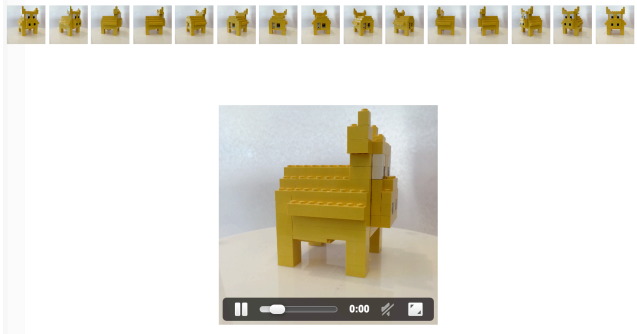

Figure 5: Photographs from Turntable and compiled video

After the animation is compiled, the user can add a name to their *spin*, add an optional visual *tag* element for annotation, and share their spin directly on Twitter and Facebook [Figure 4]. Additionally, they can export the video or GIF file to upload on any alternative social network.

3.3 Web Viewer

The web viewer enables users to view their *sets*, or all spins associated with a particular project, on a timeline with its corresponding annotations [Figure 6].

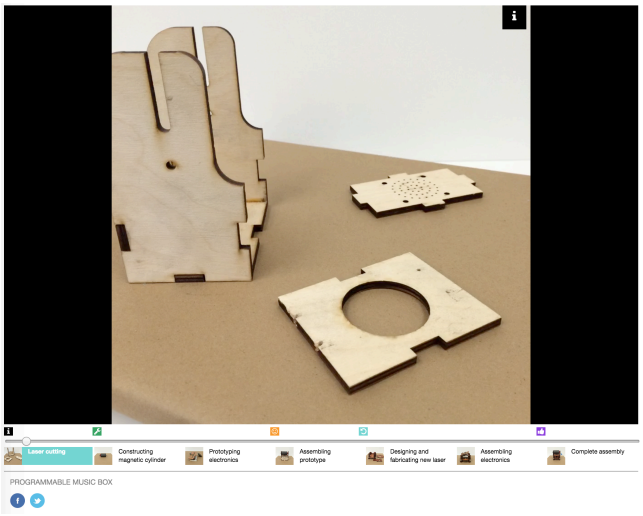

Figure 6: Spin web viewer

The timeline was designed for easy browsing, with a scrubbing interface to browse through the project at the user's selected pace. Through the web viewer, authors can also share their project to Twitter or Facebook.

The visual tags selected by the user are also represented on the timeline in an effort to highlight important moments in the design process [Figure 7].

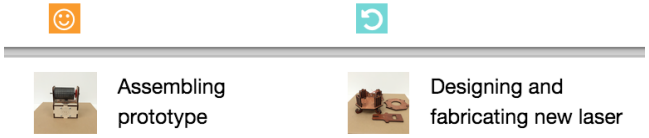

Figure 7: *Tags* displayed on timeline interface

Overall, the Spin platform was designed to integrate with other social networks. Rather than develop and grow a separate Spin community, users can share their projects on networks they already utilize.

4. FUTURE WORK

In the coming months, several Spin turntables will be fabricated and distributed to select Makerspaces across the United States to be used over the course of two months. During this time, the researchers will monitor the spin animations created using the system and interview the participating users about their experiences. In particular, the following questions will be explored:

1. When are spin animations created during the design process, and how often are they created throughout a design project?
2. Where are they shared, and with whom? Are there strategies the users employ to solicit feedback on their designs?
3. Are there any "hacks" users create to appropriate the turntable to work within their particular environment (such as lighting, custom phone stands, etc.)?

This research will forefront youth's motivations for creating design documentation and study strategies young Makers use to capture their design process.

5. ACKNOWLEDGMENTS

This work is supported in part by the National Science Foundation Graduate Research Fellowship under Grant No. 1122374. Thank you to Geoff Tsai and David Mellis for their design feedback and to Amber Meighan for her development work on the iOS app.

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