ThorDMX: A Prototyping Toolkit for Interactive Lighting Control

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CHI'13, April 27 – May 2, 2013, Paris, France.
ACM 978-1-XXXX-XXXX-X/XX/XX.

Abstract
ThorDMX is a lightweight prototyping toolkit for rapid and easy design of new lighting controllers. The toolkit provides a framework, code samples and tutorials for quickly developing new controller interfaces using familiar prototyping tools and software. Aimed at prototyping interaction designs for DMX lighting control it facilitates the exploration of expressive, collaborative and flexible new interfaces.

Author Keywords
stage lighting; interaction design; prototyping; performance; interface design;

ACM Classification Keywords
H.5.5 Sound and Music Computing

General Terms
Design, Human Factors

Introduction
We present ThorDMX, a prototyping toolkit which enables prototyping of lighting controllers. The ability to prototype interaction technologies and interfaces designs in this domain has been limited due to cost and complexity of existing lighting equipment, ThorDMX provides a simple framework for prototyping new lighting interfaces in both hardware and software. Interface prototyping is a common design practice in

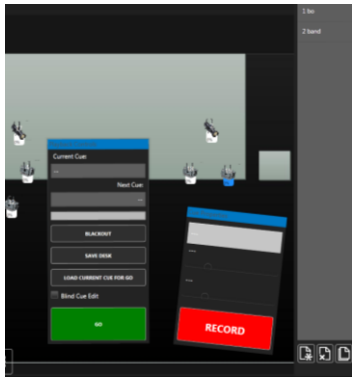

Figure 1 Theatre control using a multi-touch tabletop

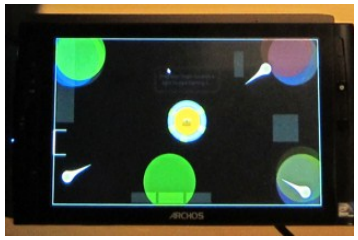

Figure 2 Finger Painting Tablet Controller

many domains, allowing users to try out, test and deploy new interfaces without extensive or costly product development. ThorDMX enables this practice for lighting control by abstracting the complex and proprietary protocols used, permitting designers to focus on interaction and interface concepts. By providing libraries, code samples and APIs for common languages and platforms, users can rapidly develop prototype control interfaces which are interoperable with existing hardware lighting systems.

What Prototyping Brings to Lighting

Facilitating Collaboration

Existing control interfaces are primarily aimed at single user interaction. Designing collaborative controllers could benefit the planning phase, for example using a tabletop plan view of an area to bring together the lighting designer and technicians (Figure 1) to collaboratively try out creative ideas without any technical knowledge.

Facilitating Flexibility

Lighting controllers operate on a multitude of proprietary hardware and software protocols [3], and are difficult to develop interfaces for. Although software tools are available for 3D visualization, offline design [4] and planning and operation[1] of complex lighting systems, control devices (if at all) maintain only device specific information about the venue. Producing easy to understand visualizations of the scenario in real-time would allow users to appreciate complex control scenarios quickly.

[1] goo.gl/AQWBd

Facilitating Expression

Often operators embody expression through their control equipment as with a musical instrument, responding to the music, audience and ambience of a space with lighting and effects. By designing a custom interface on a Tablet PC (Figure 2), an operator could control lighting whilst standing within the space using controls they developed for the task. Many existing controllers rely on traditional interfaces such as faders, dials or keyboards and mice, rather than more expressive interaction modalities and although resources exist for non-technical users to understand lighting [1], nothing is a substitute for enabling real-time control.

Facilitating Participation

Traditionally lighting is designed and operated by professional crew, but new interfaces could be developed for interactive lighting, such as a collaborative 'finger painting' tabletop application placed in the space (Figure 3). This could enable the audience to control colored lighting by mixing colors like paint. By allowing multiple controllers with specialized functionality, aggregated or collaborative controllers can be developed. Previous systems such as codeBlue [2] have demonstrated the possibilities of audience interaction with lighting using distributed wireless sensors to engage participants.

Existing Solutions

To light a space, lights, dimmers, infrastructure and a control system need to be installed and configured. Each light (or lamp) in the 'rig' uses a particular number of 'channels' to control it. These numbers bear no relation to the hardware they control. A traditional lighting control console consists of mappings, faders

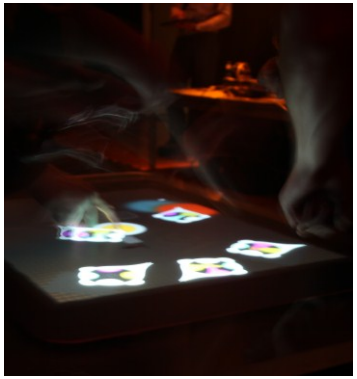

Figure 3 Audience Finger Painting with Lighting

Figure 4 Pearl 2010 Live Lighting Desk

and controls for manipulating these channels to produce lighting scenes. Many complex tasks are carried out on lighting consoles e.g. recording cues, fading between states, color mixing and moving light control, and they are often complex PC based devices needing experience and skill to operate (Figure 4).

The Toolkit

The ThorDMX toolkit consists of two elements: 1) a simple controller toolkit APIs and documentation enabling the design of new control interfaces in multiple languages and platforms 2) a centralized 'protocol broker', software that connects directly to the physical lighting equipment. The software is free, and only a ~$70 device[2] is required to connect it to an existing hardware lighting system.

Controller Development

Controllers can be developed using a wide variety of prototyping technologies. Currently Web Sockets, OSC, ZeroMQ, UDP and Electrical DMX are all supported, and libraries for these protocols exist in many languages and in many platforms. Full example implementations are available in C# and Python[3], demonstrating server discovery, downloading a representation of the lights, controlling lights and getting the state of the rig. Detailed documentation is provided along with examples of how to integrate with these features and example code. These initial protocols have been chosen as they specifically integrate well with hardware prototyping platforms such as Arduino, .NET Gadgeteer and Raspberry PI, allowing the rapid development of tangible, wireless or sensor based controllers without major hardware or protocol development.

Server Software

ThorDMX removes the dependency on both physical connection and use of particular software libraries to control a lighting system. A centralized 'protocol broker', simply a software application which acts as a central point for all interfaces attached to lighting hardware (Figure 5), routes all control information between devices and the physical lighting installation.

Figure 5 Control Infrastructure

The ThorDMX Server exposes simple lighting commands ('update channel', 'update all', 'blackout') through a variety of protocols, enabling users to create novel and unique control interfaces using existing prototyping and software tools. To get developers started even faster, ThorDMX can use a local wireless network, so no extra infrastructure is required to start controlling a rig. ThorDMX advertises itself onto this network using Bonjour (ZeroConf), for automatic configuration and if required provides feedback to controllers on the current state of the lighting system. This is especially useful if multiple controllers are operating simultaneously, as all controllers can be aware of the effect they are having on the system. The ThorDMX server provides communications functionality through a system of plugins. This enables simple and

[2] goo.gl/rt6QX

[3] http://ips.codeplex.com

Figure 6 HTML5 Mobile Controller

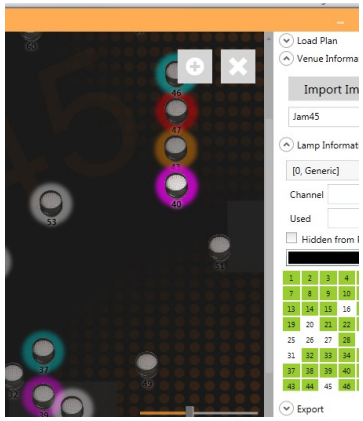

Figure 7 Visual Space Editor

rapid inclusion of additional control protocols e.g. MIDI, OpenDMX and STOMP.

Once initialized, ThorDMX provides a mobile controller or 'riggers remote' on a user's own mobile device via the network. Without additional equipment, this HTML5 mobile application can control any lighting in a space so that rigging can start immediately (Figure 6). Multiple devices can also connect to ThorDMX, for example: a rigger inside a building can be changing individual lights, while another can be simultaneously programming a colored wash on the outside using a tablet PC.

Space Representation

Typical lighting setups are complex, so it is helpful to maintain a centralized representation of what is available to control. If required, a controller can request this representation from the ThorDMX server as a simple JSON file. This file contains information on type, channels and availability of lights, as well as color and descriptions if known. An image representing the space, onto which each light has a relative position for controllers to render is also included. A visual editor is included in the toolkit (Figure 7). This tool creates and uploads a representation file to the server with a spatial representation of lighting which can then be interpreted by controllers. It is expected that editing the venue need only to be done when physical lighting changes within the space.

New Interactions Using ThorDMX

In the context of city based or architectural lighting, ThorDMX enables the development of novel interactive lighting controllers, for example:

1. Street lighting can be controlled by detecting the number of people in the locality by detecting WiFi and Bluetooth signals from nearby mobile devices.
2. Lighting conditions for public areas can be crowd sourced from social media such as Twitter, enabling a pseudo democratic control of building color washes.
3. Space lighting can be controlled by a mobile device with a pictorial representation of the area, whilst the operator is standing within the space to experience the effect.
4. A space can respond to a live music event within the area, allowing the ambient lighting in the venue to become part of the performance.

References

1. Campbell, D. *Technical Theater for Nontechnical People*. Allworth Press, 2004.
2. Hromin, D., Chladil, M., Vanatta, N., et al. CodeBLUE: a bluetooth interactive dance club system. *GLOBECOM '03. IEEE Global Telecommunications Conference (IEEE Cat. No.03CH37489)*, IEEE, 2814–2818.
3. Jiang, W., Jiang, Y., and Ren, H. Analysis and prospect of control system for stage lighting. *2010 3rd International Congress on Image and Signal Processing*, IEEE (2010), 3923–3929.
4. Stephenson, I. Digital Relighting for Stage Use. 2008. http://eprints.bournemouth.ac.uk/7166/1/licence.txt