A Multi-Platform Library for a Software Sender for the (proposed) ILDA Digital Network

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Abstract — this software demonstration presents work of the Laser & Light Lab at the Institute of Computer Science 4 of the University of Bonn on proposed standardization work of the International Laser Display Association (ILDA, [2]). The Laser & Light Lab (as a nonprofit ILDA member) got involved into a proof-of-concept implementation of a software-based sending side of the (proposed) IDN — ILDA Digital Network, implementing this as a multi-platform (Linux, Windows) library that can be attached to existing laser show control software.

The demonstration presents a setup with professional/commercial laser show software, as well as software coming from own student/research projects, both supplemented with our software library for IDN. The demonstration will highlight two modes of operation of IDN and will focus on illustrating conceptual differences of both modes with a discussion of pros and cons.

I. INTRODUCTION & MOTIVATION

Laser show systems can be considered to be among the most visible applications of lasers and probably the most entertaining ones. Introductory information on how laser shows work can be found in [3]. Some relevant basic information on these systems and their relation to the topic area of computer networks have been given in some demonstration papers of the same author, see [4] – Publications/Demos.

Relevant for the network related aspects of our demonstration are the following three types of elements that are needed to run a laser show system:

- A computer, running the laser show software, that is able to control one or more laser projectors
- One or more laser control interfaces, each controlling one laser projector
- One or more laser projectors, each projecting colorful beam or screen effects coming from a single laser beam redirected in X- and Y-orientation (examples see [3])

To connect these elements, there are several standards that are in use. The typical way to connect a computer with the laser control interface(s) is via USB (Universal Serial Bus) or over a TCP/UDP/IP based local area network.

The connection between a laser control interface and the laser projector typically is done according to the so called ILDA Standard Projector (ISP). The ISP [2] is one of the relevant standards of the ILDA; the majority of commercially available laser projectors offer an ILDA ISP-DB25 input. The ISP defines some hardware configuration, among others the ISP-DB25, a DB25 connector and (analogue) signal specification for the cable connection between an ILDA-compatible laser projector and a laser control interface.

It has to be noted that the ISP connection uses analogue signals, generated in the laser control interface, received by the electronics of the laser projector to directly control the X-Y-scanning systems and the laser modules for each color. Between the laser control interfaces and each laser projector an individual DB25 cable is needed. If a laser control interface is connected to the computer with USB, the ISP-DB25 may have significant lengths of several 10’s or 100’s of meters, depending on the overall scenario and topology of the laser show setup. The analogue cabling quickly becomes subject to interference (signal level distortion, ground loops …) which may significantly degrade the laser show projection quality.

Another option of connecting the computer to the laser control interface(s) is via a local network. The development of this concept already started some years ago, commercial products on this became available in recent years (e.g. the so called NetLase interface, manufactured by [6] for own integration into a laser projector; the “Infinity ShowLaser” projector manufactured by [5], the Pangolin QM2000.NET [7], or Moncha.NET [8] – among others).

The advantage of a laser system set-up with network-based control is the digital transmission of the relevant data over longer distances. The physical network technology might be Ethernet or Wireless LAN, the Internet Protocol family with IP and TCP or UDP most probably is used as protocol suite for OSI layers 3 and 4. The laser control interface typically still is connected to the laser projector via the ISP-DB25, but as the control interface is closely located to the laser projector (or integrated into), the lengths of the (analogue) cable/connection is short and therefore interference issues are minimal.

Unfortunately, this concept of digital transmission of laser projection data is currently only available in proprietary solutions of commercial products. At least some of the vendors offer a documented library API to allow own laser show
software to control the respective laser control interface via the network. But the protocol used between the software library and the laser interface is not documented. Other solutions are fully closed and by intention the operation from specific laser show software is only possible with a (network-controlled) laser control interface coming from the same vendor. Among these are also solutions extending the USB over Ethernet/IP, still limited to a special combination of software and hardware.

Meanwhile the ILDA has started discussion on network-based laser projection within its technical committee and in the annual ILDA conference. Mid- to long-term goal might be to develop another open ILDA standard for digital transmission of laser projection data over packet oriented networks to allow different types of laser show software and different types of laser projection systems to interact (working title “IDN – ILDA Digital Network”).

The Laser & Light Lab [4] of the Institute of Computer Science 4 at the University of Bonn (in the following short “Uni-Bonn-LLL”) builds on conceptual and programming experience in networked environments for laser show projections systems, as was already presented in conference demonstrations, see [4]. Currently, Uni-Bonn-LLL as a non-profit ILDA member contributes to the IDN development and proof-of-concept implementations. The activities are coordinated by the author; the implementation (and evaluation) is carried out in student projects in the computer science department of Uni Bonn.

II. SUBJECT OF THE NETSYS 2015 DEMONSTRATION

The demonstration for NetSys 2015 will present a setup with professional/commercial laser show software, supplemented with our software library for IDN, on a Windows system, as well as the operation on a Linux system with own laser show software. A laser projector will be brought to the demonstration to see the system in full operation.

More information on the IDN basics with different envisaged scenarios can be found in the LCN 2014 demo available at [4]. In our NetSys demonstration, the laser picture data will be sent from software over a local network directly to a dedicated piece of hardware, the so called “StageMate ISP” [1], a prototype hardware/FPGA receiver for IDN. A single (possibly very long) link with 100 Mbit/s or 1 Gigabit/s will transmit the accumulation of several IDN laser data streams (one stream for each laser projector of a real world scenario).

The NetSys 2015 demonstration will show two modes of operation, the so called wave mode of IDN, and the so called frame mode. The wave mode equals typical multimedia communication with real-time requirements, as a stream of laser samples is sent over the network with considerably high rates (100 kHz sampling rate results in ~12 Mbit/s data rate).

In the frame mode, the receiving part will get the complete data for a full laser picture; the repeating scan of the picture will be done in the receiving side. This changes the requirements for the network transmission, and offers additional features – a detailed comparison of both modes with requirements (in particular on our sender implementation of IDN) and pros and cons will be discussed and demonstrated with the NetSys demo.

III. CONCLUSION

The main subject of the NetSys 2015 demonstration is the software library implemented by Uni-Bonn-LLL to be attached to existing third-party or own laser show control software, to send laser picture data over a digital network according to the (proposed) IDN protocol.

The relevance to the field of application is high, as there are other systems that try to meet the same goals (cf. section I). The major strength of our library is the support of an open protocol (IDN) that is currently subject of discussion for international standardization. The implementation of the library can be seen as a reference implementation, showing the feasibility and giving a proof-of-concept of realizing the proposed IDN protocol to work together with existing (third-party) laser show software. This may encourage other players in the laser show display business to adapt their software and/or hardware to the proposed IDN standard.

Our IDN library is licensed under BSD license. However, it is not yet clear in detail how and when to publish the library. In the context of ILDA IDN standardization, the library will be available to contributing parties. Currently it implements two APIs (application programming interface) that have been published and are in use for interfacing between existing, already on-the-market laser show software and laser controller drivers. An adaption to other APIs is probably easy, as the interfacing concept for typical laser show systems is rather similar.

At the moment, the library is realized for Windows as a DLL (dynamic link library) and for Linux as a static library. The library link type maybe changed; furthermore a port to Mac OS X is likely to be possible with reasonable effort.

IV. ACKNOWLEDGEMENTS

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REFERENCES