Master's Thesis Engineering Technology

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Person tracking with a DMX-control system on FPGA for stage lighting and entertainment industry

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Background

There is a demand for **automation** in the **professional audiovisual industry**. One of those things is automating a **follow spot** which is normally operated manually. Some similar systems have already been released, but we will tackle the problem from a different angle. The approach is to use a **field-programmable gate array** (FPGA) as a central **controller**.

Objectives

1) Determine a suitable tracking system
2) Integration of the tracking system into a central system
3) Data processing of communication
4) Design of the DMX512-A controller on the FPGA
5) Testing the person tracker

This research was done for DSV-Rent with the help of the research group ES&S of KU Leuven

[1]

Person tracking system

Marvelminds

[2]

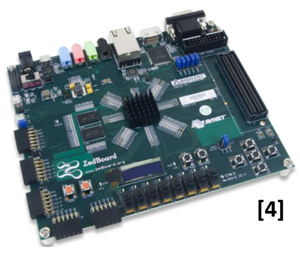
Ez-con6

[3]

UART

DMX

ZedBoard development kit



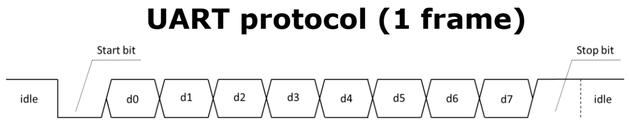
[4]

DMX

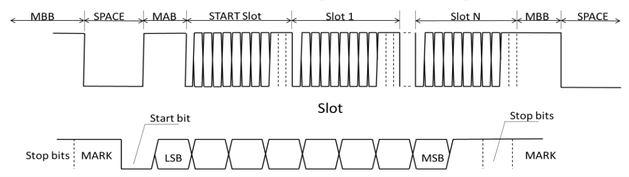
Moving head Spotlight

[5]

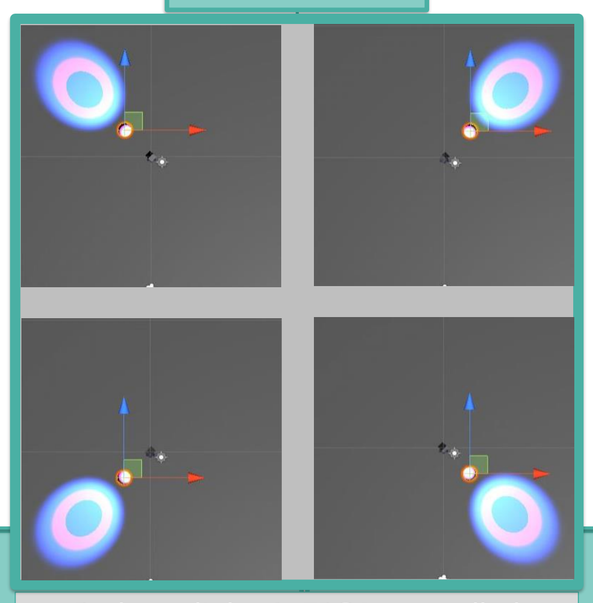
UART protocol (1 frame)



DMX512-A protocol (universe and slot)



RESULT

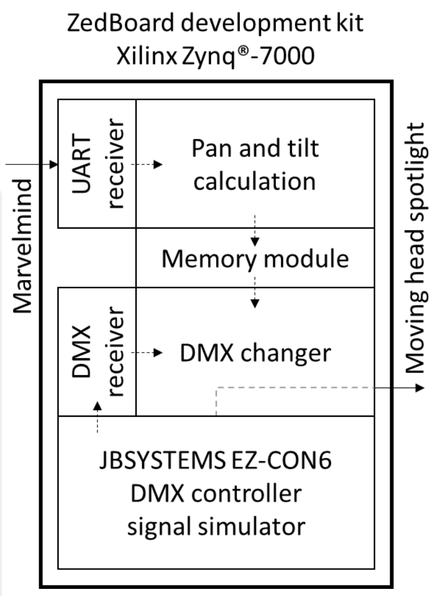


Red spotlight → FPGA controlled
Blue spotlight → Ideal spotlight

Conclusion
Works for all the quadrants
Maximum added delay of 1 universe
Flexible, low cost, POC design

Further work
Ready to be tested in practice
Multiple lights, focus, colour

FPGA DESIGN



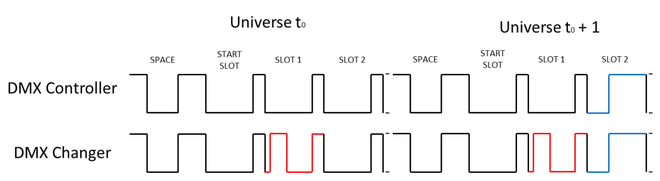
Used resources

	Slices	Block RAM Tile	DSPs
Total	609	30,5	2
DMX Controller	476	0	0
Marvelmind	6	0	0
slot memory ram	34	0,5	0
DMX Receiver + Sender	1	0	0
TILT PAN	38	30	2
UART rx	15	0	0

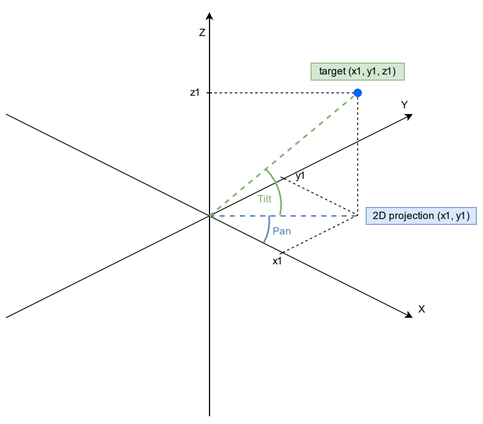
- Design on the FPGA for simulation
- Low resource use of the ZedBoard FPGA
- Cheapest option → Xilinx XC7A50T
- 1 ZedBoard → 2 systems

Implementation

DMX changer



Pan and tilt



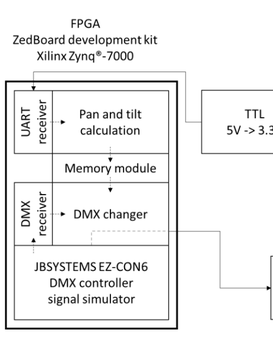
- Positioning for moving head spotlight
  - 16 bits pan 540°
  - 16 bits tilt 540°
- Use of CORDIC to calculate angles on FPGA
- Save 4 times 8 bits for 4 slots
- DMX changer reads pan and tilt values
- Paste onto the slots

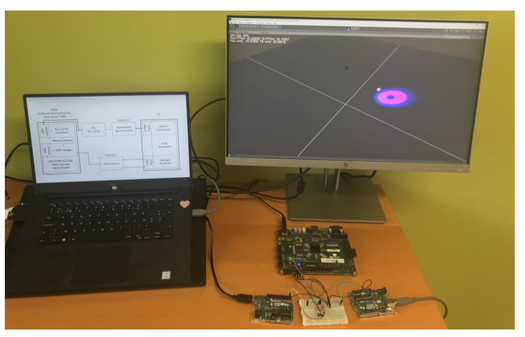
Simulation

unity [6]

ARDUINO [7]

- Unity simulation environment
  - Proof of concept
  - Spotlight
  - Person
- Arduino 1: Marvelmind simulator
- Arduino 2: DMX receiver
- Simulation DMX controller on FPGA





LIVE PREVIEW

Supervisors / Cosupervisors: Dr. Ing. Vliegen Jo
Dhr. Daniëls Kristof

EMBEDDED SYSTEMS & SECURITY

DSV-RENT EVENT SUPPORT

[1] "Lighting engineer with DMX controller" [Online]. Available: https://www.adlib.co.uk/uncategorized/ma-lighting-grandma3-has-arrived-in-rental-stock/
[2] "Marvelminds starter set HW v4.9-NIA." [Online]. Available: https://marvelmind.com/product/starter-set-hw-v4-9/
[3] "JBSYSTEMS ez-con6" [Online]. Available: https://jb-systems.eu/ez-con-6
[4] "Zedboard zynq-7000 arm/fpga soc development board." [Online]. Available: https://www.xilinx.com/products/boards-and-kits/1-elhabt.html
[5] "Stairville MH-x60 LED Spot Moving Head." [Online]. Available: https://www.thomann.de/gb/stairville_mh_x60_led_spot_moving_head.htm
[6] "Unity logo" [Online]. Available: https://unity.com/
[7] "Arduino logo" [Online]. Available: https://www.arduino.cc/

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