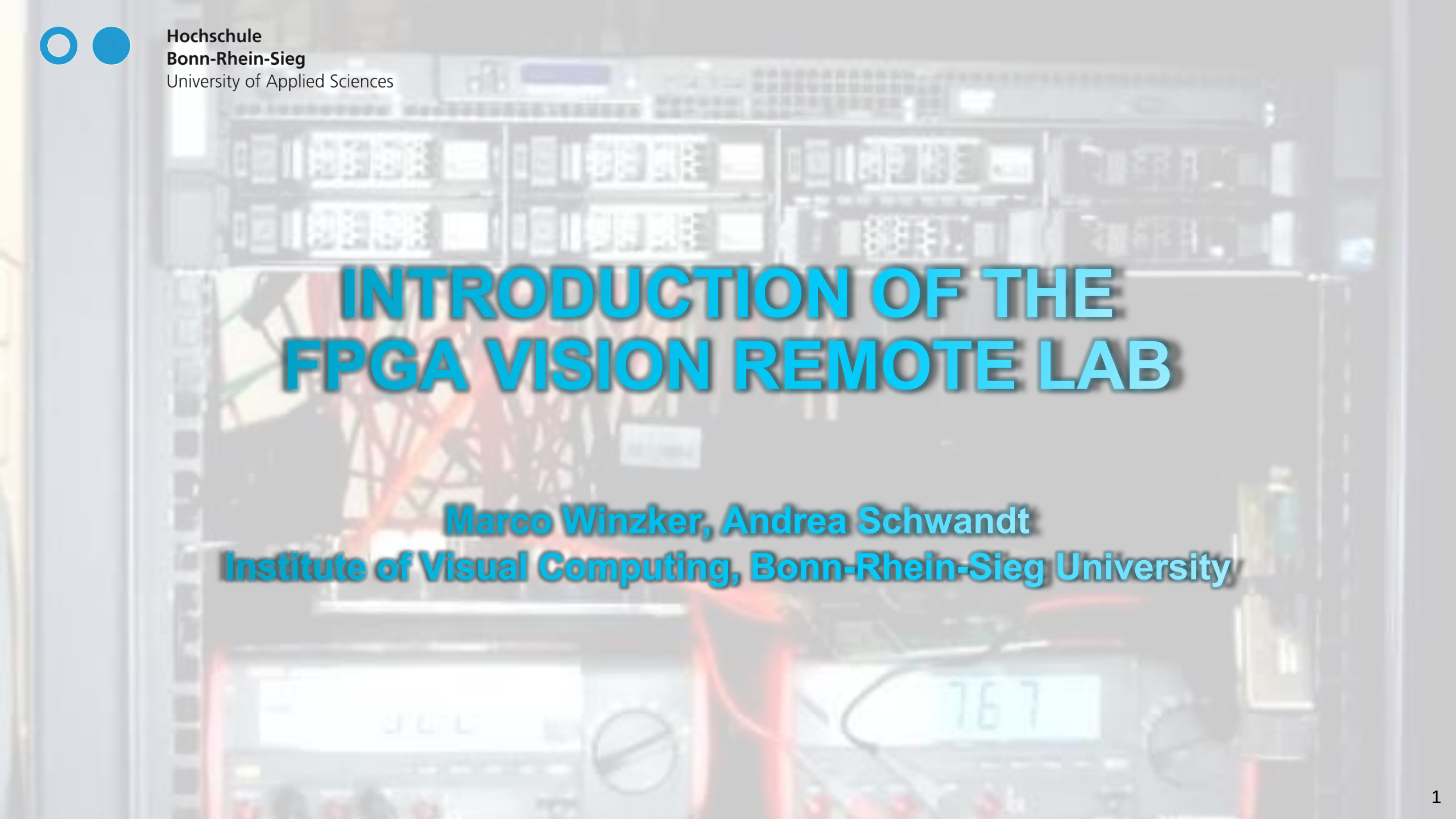

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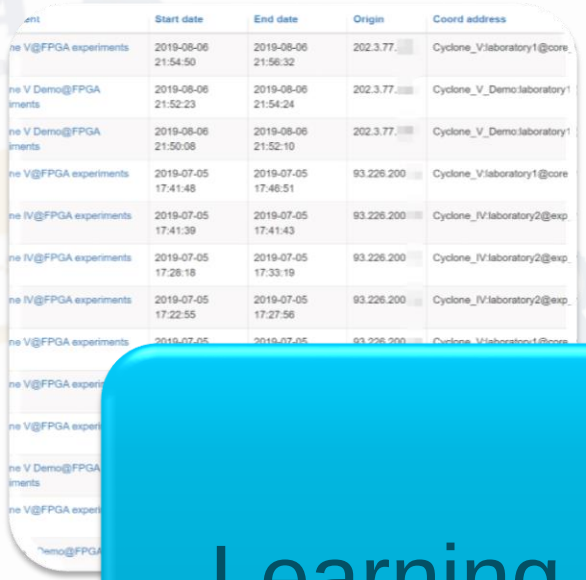
INTRODUCTION OF THE FPGA VISION REMOTE LAB

Marco Winzker, Andrea Schwandt
Institute of Visual Computing, Bonn-Rhein-Sieg University

Topics

The FPGA Vision Remote Lab – Making-of

Learning Goals



Learning Analytics

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THE FPGA VISION REMOTE LAB
-
MAKING-OF

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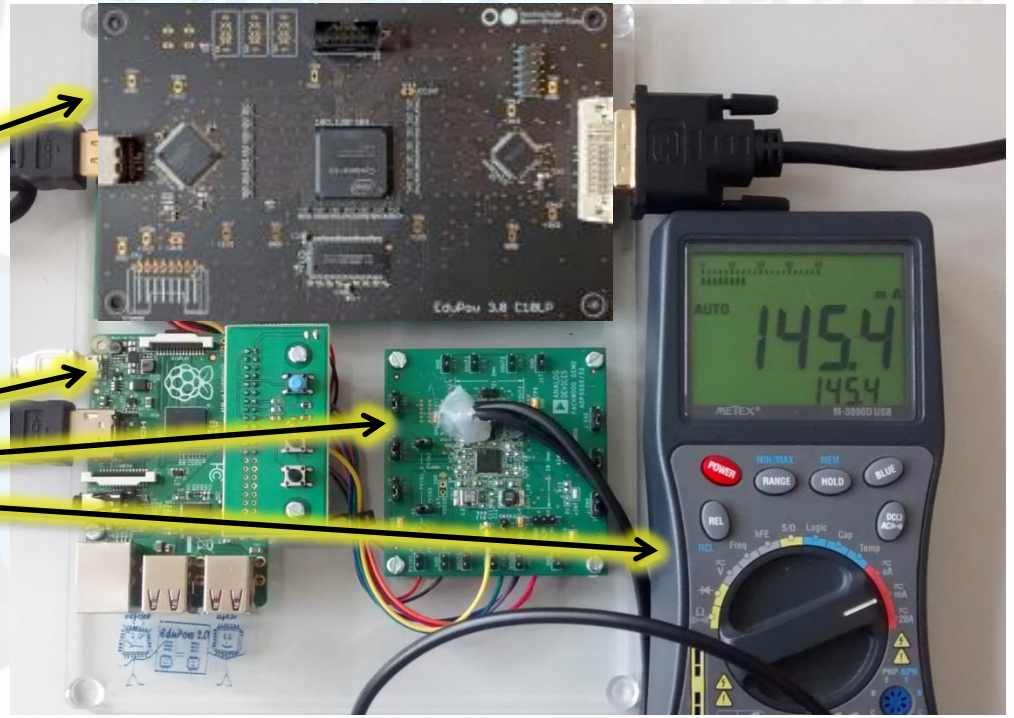
From EduPow…

- Development of board for module „Energy Efficient Microelectronic Systems“

FPGA Design developed at H BRS

Available components



Coming Soon

⇨ since January 2015 [illegible] Open Educational Resource (OER)

- Lab hardware available via Internet
  - ⇨ Students can access the lab hardware independent from time and their current whereabouts

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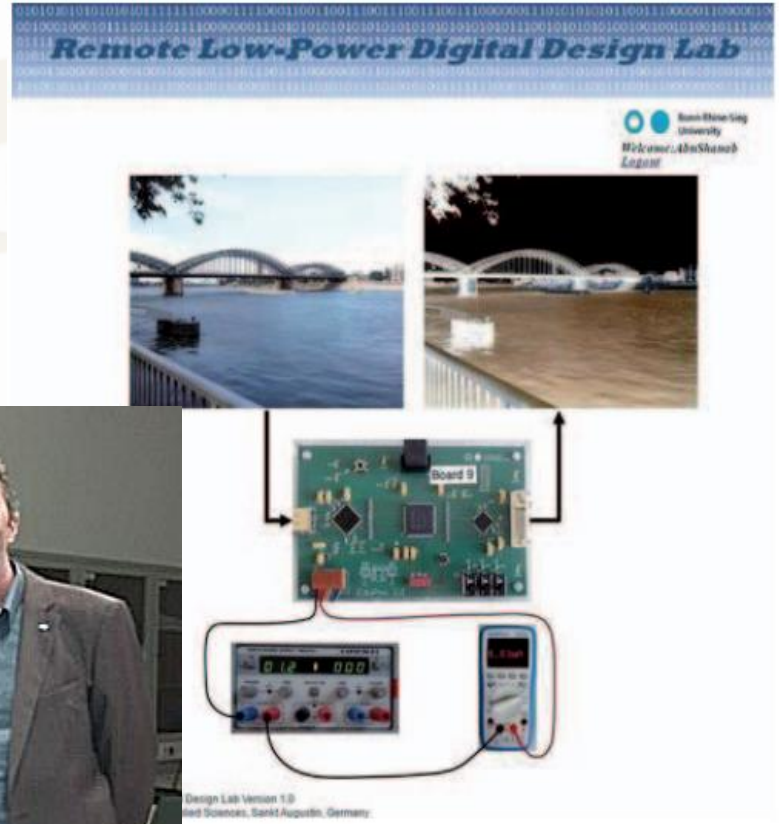
… to prototype …

- Prototype for proof of concept designed
  - in-house development
  - possibility to log-in, upload one compiled FPGA design and one image
  - fundamental presentation of results
  - basic session handling
    - log-in locks the system for three minutes
    - no queuing



- Used and evaluated by students during summer terms 2016 and 2017
- Evaluation confirms proof of concept

Shatha Abu Shanab successfully completes her doctorate

… via redesign …

What do we need for a successful remote lab?

- OER (Open Educational Resource) distribution
- reliable availability
  - 24/7
  - long-term
- usability
  - comfortable session handling
  - straightforward user interface
  - experiments with interactive control elements

consider students' perspective

…and approach for redesign…

- Usage of the WebLab-Deusto Remote Lab Management System

  - ✓ user handling and queuing already implemented
  - ✓ data logging for learning analytics available
    - ⇨ concentration on the design of the experiment (hardware, software and user interface)

- Straightforward user interface of experiment page

  - starting with the most important input elements, e.g., where users can upload binaries, on top of the page
  - logical, coherent arrangement of in- and output elements
  - provision of several images and the possibility to upload own pictures as input image for the FPGA

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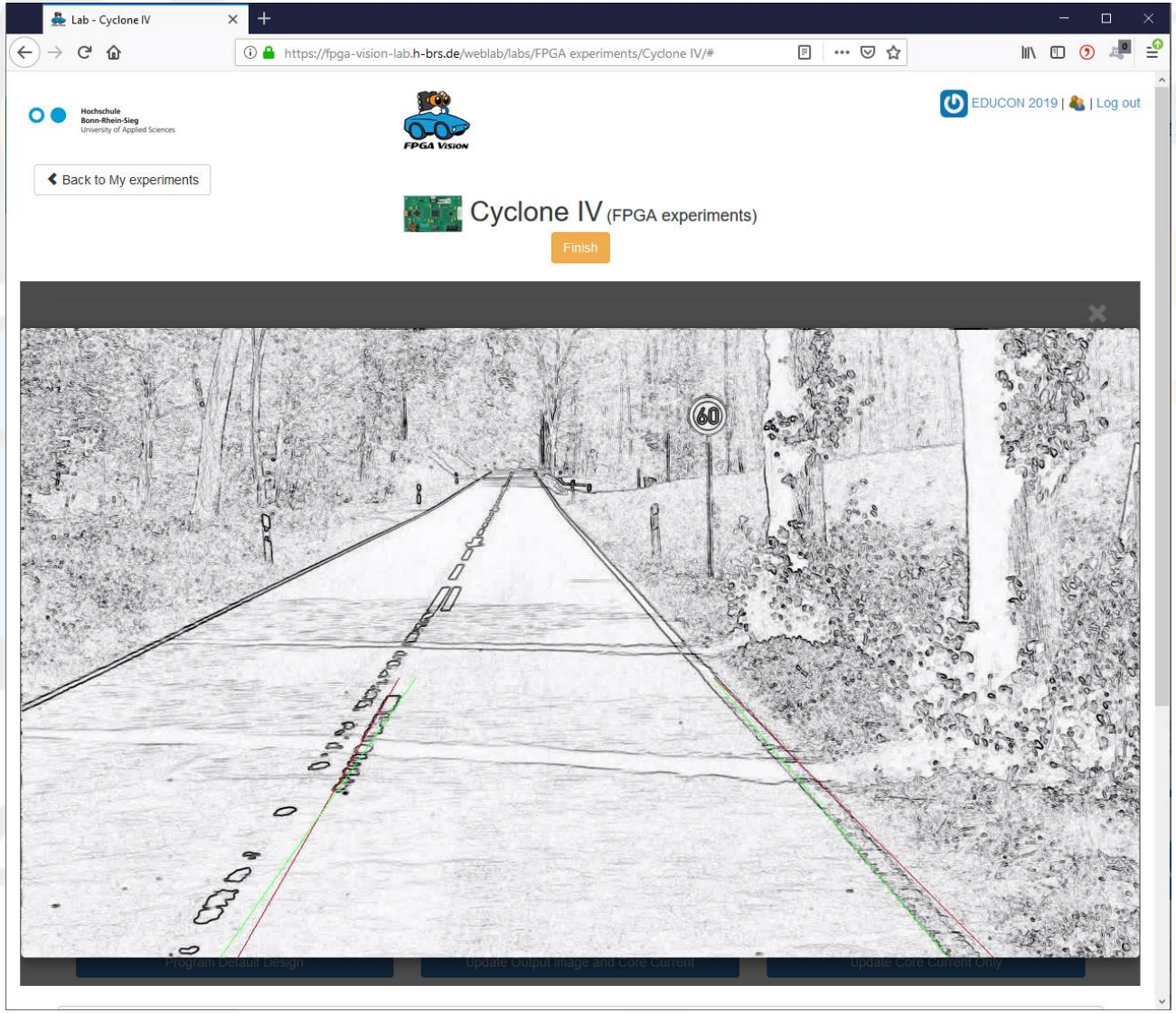
… to the FPGA Vision Remote Lab



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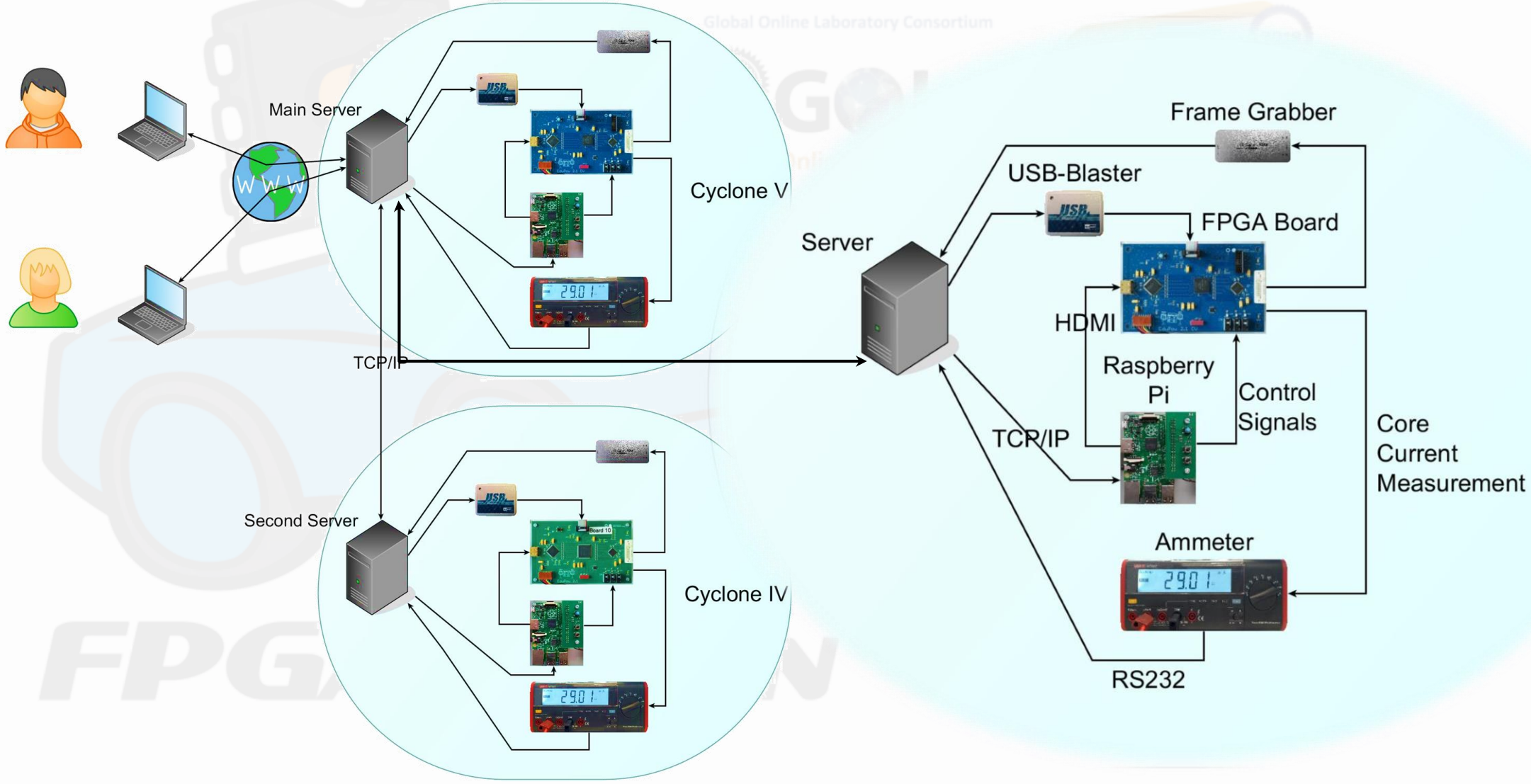
Structure of the FPGA Vision Remote Lab



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Hardware of the FPGA Vision Remote Lab

Screenshots from “Behind the Scenes of the FPGA Remote Lab”
(https://www.youtube.com/watch?v=RjiaqSRyPuw&ab_channel=MarcoWinzker)

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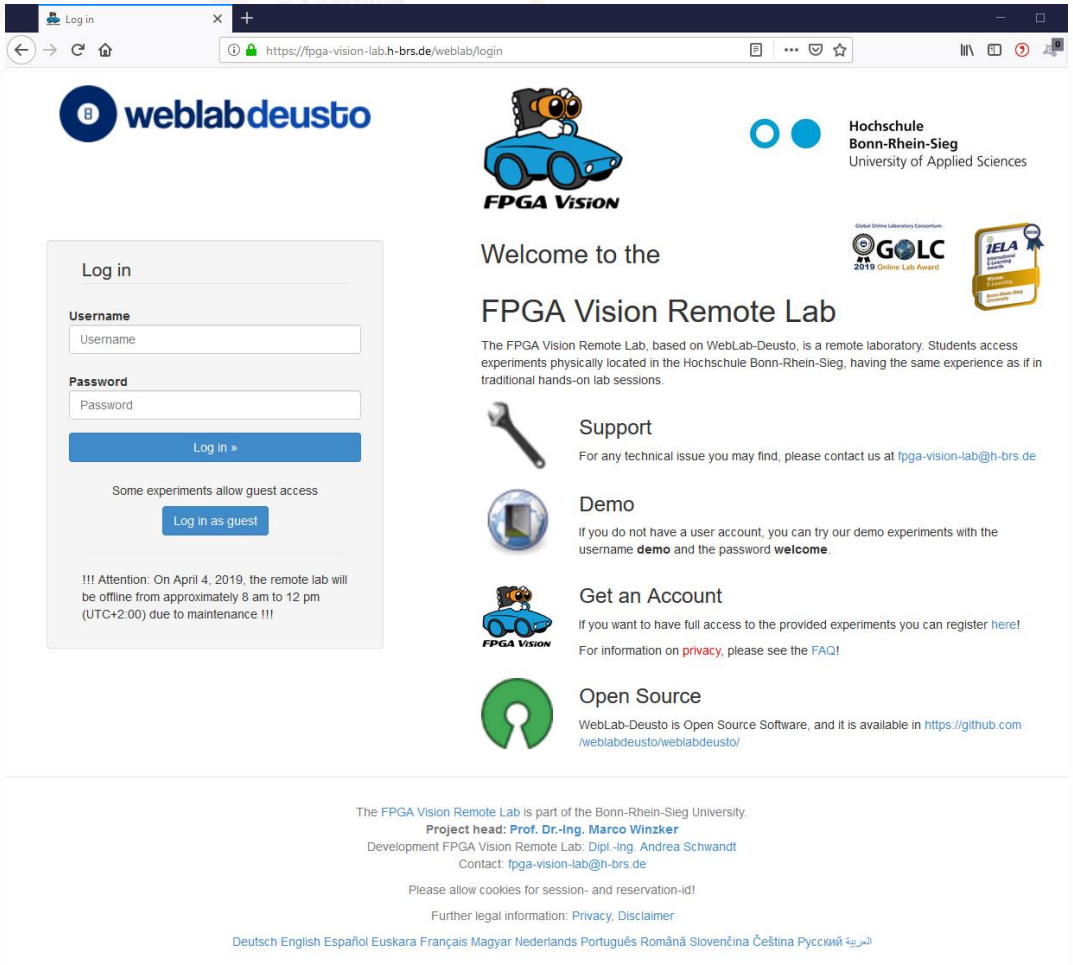
Make it open!

- remote lab is open to other universities and individuals
- demo experiments accessible without registration
- free user registration
- short video lectures on YouTube complete the learning offer



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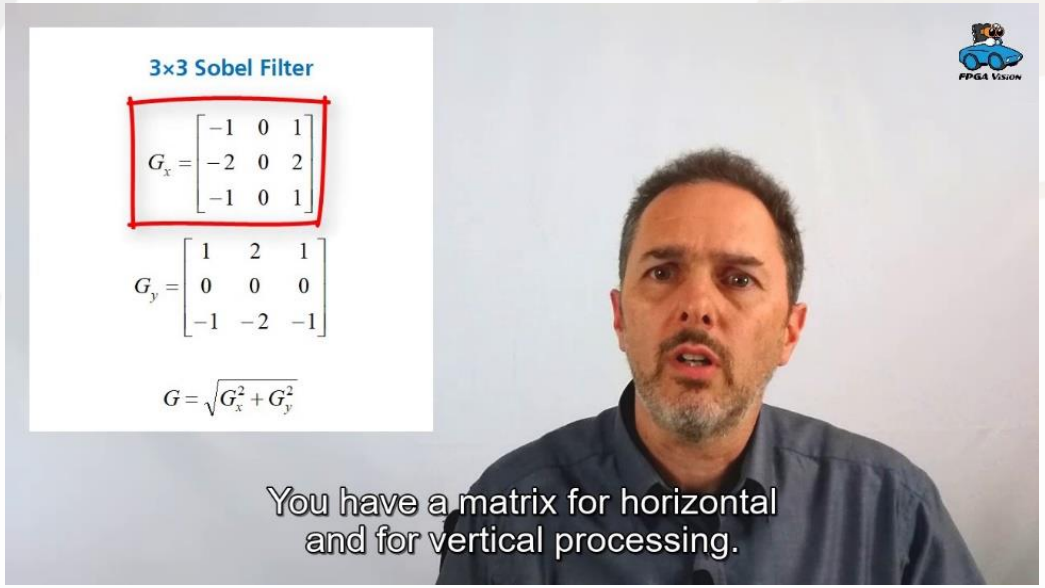
Remote-Lab-Lecture

Approach for distance education

- Video lectures for instructions
- Remote-lab for applying the knowledge
  - ⇨ Our name for this combination of formats: **Remote-lab-lecture**
- Open educational resource (CC-BY)

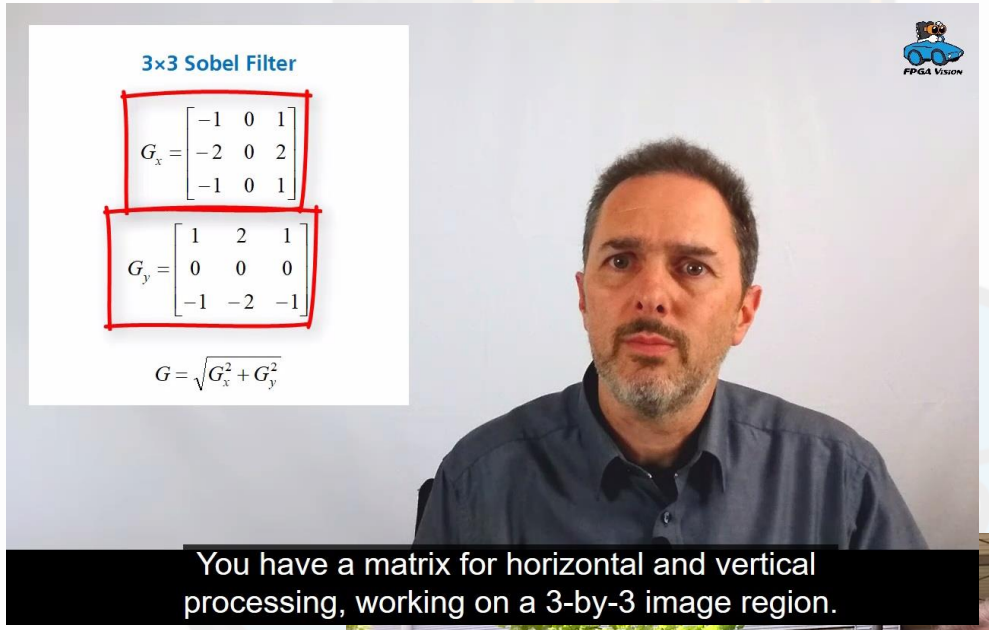
Seven video lectures

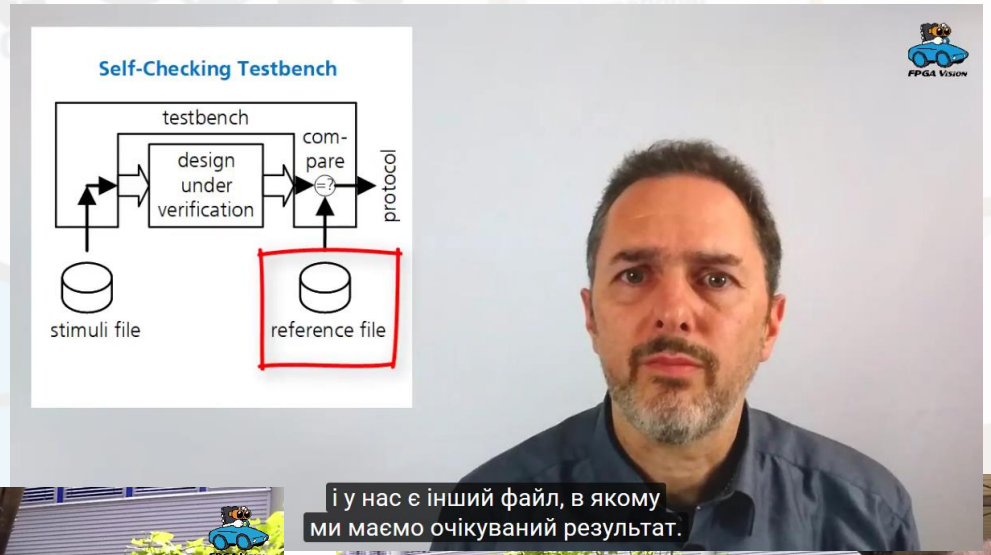
- Between 3 and 15 minutes
- English with subtitles

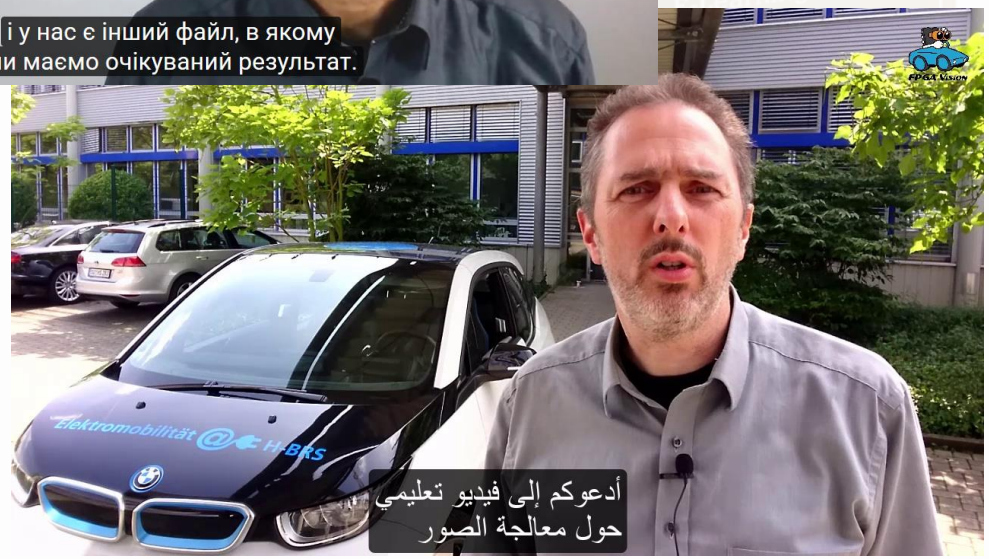


Remote-Lab-Lecture II

- subtitles in different languages







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LEARNING GOALS

Educational Goal

- State-of-the-art education should consider demands of
  - students in need of more time,
  - more learning opportunities for ambitious students,
  - flexible schedules for students caring for children or dependents in need of care.

- Providing remote labs is one possibility to meet these conditions:
  - possibility to work with real hardware
  - available 24/7
  - accessible via internet

    ⇨ independence of time and space

Students' feedback

Feedback on the FPGA Vision Remote Lab:

- Possibility to finish tasks from hands-on lab.
- We have more time to experiment, more than in the hands-on lab.
- Work with real FPGAs at home.
- Independence from time and location.

⇨ profit for thorough students

⇨ opportunities for ambitious students

⇨ enhanced possibilities providing flexibility

⇨ students exploit the additional learning opportunity and like working with the FPGA Vision Remote Lab

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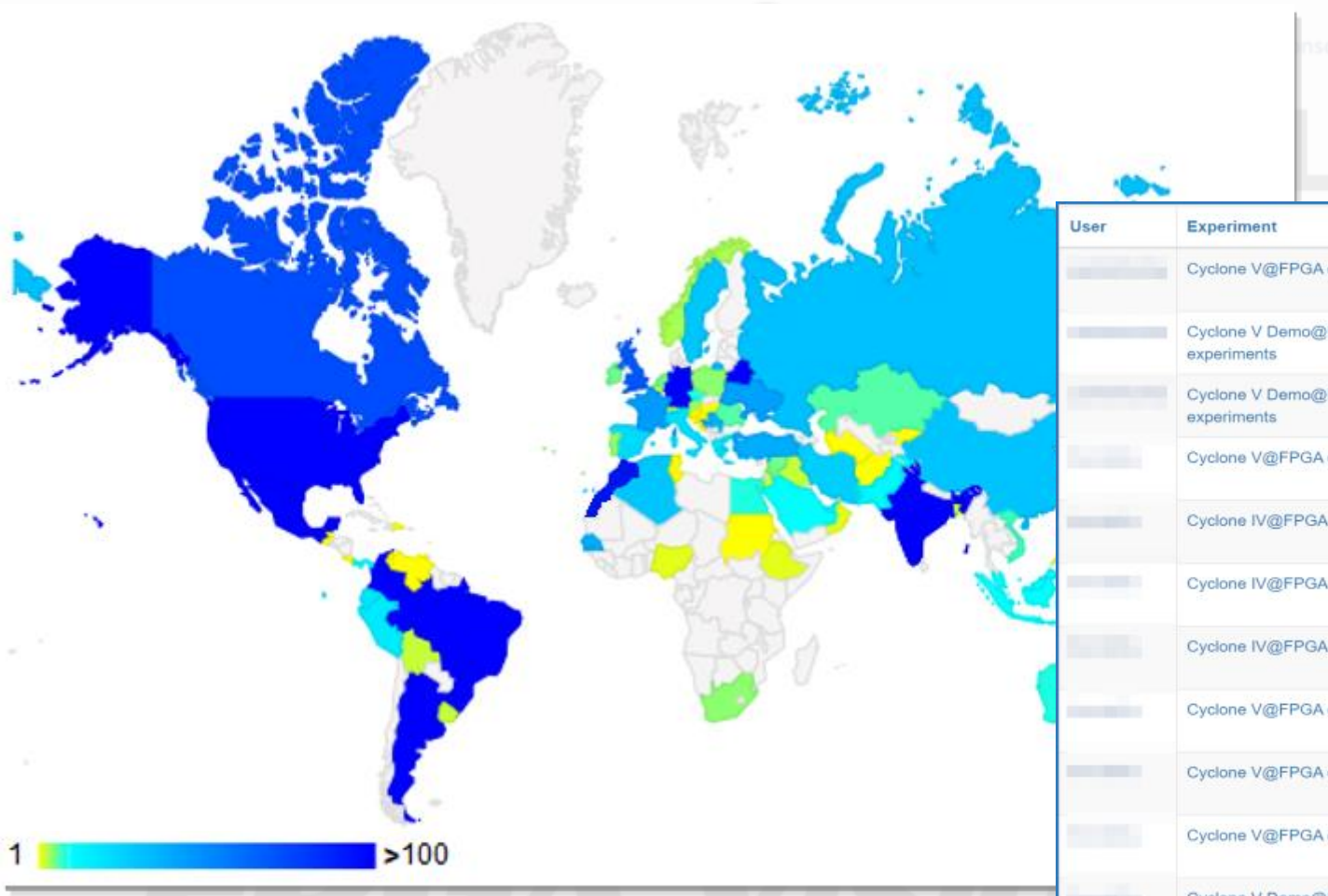
Cyclone V Demo@FPGA experiments	2019-08-06 21:52:23	2019-08-06 21:54:24	202.3.77.	Cyclone_V_Demo:laboratory1@core_host	Details
Cyclone V Demo@FPGA experiments	2019-08-06 21:50:08	2019-08-06 21:52:10	202.3.77.	Cyclone_V_Demo:laboratory1@core_host	Details
Cyclone V@FPGA experiments	2019-07-05 17:41:48	2019-07-05 17:46:51	93.226.200	Cyclone_V:laboratory1@core_host	Details
Cyclone IV@FPGA experiments	2019-07-05 17:41:39	2019-07-05 17:41:43	93.226.200	Cyclone_IV:laboratory2@exp_host	Details
Cyclone IV@FPGA experiments	2019-07-05 17:28:18	2019-07-05 17:33:19	93.226.200	Cyclone_IV:laboratory2@exp_host	Details
Cyclone IV@FPGA experiments	2019-07-05 17:22:55	2019-07-05 17:27:56	93.226.200	Cyclone_IV:laboratory2@exp_host	Details
Cyclone V@FPGA experiments	2019-07-05 16:32:03	2019-07-05 16:37:05	93.226.200	Cyclone_V:laboratory1@core_host	Details
Cyclone V@FPGA experiments	2019-07-05 16:26:50	2019-07-05 16:31:53	93.226.200	Cyclone_V:laboratory1@core_host	Details
Cyclone V@FPGA experiments	2019-07-05 16:21:38	2019-07-05 16:26:39	93.226.200	Cyclone_V:laboratory1@core_host	Details
Cyclone V Demo@FPGA experiments	2019-07-05 15:54:16	2019-07-05 15:54:42	93.226.200	Cyclone_V_Demo:laboratory1@core_host	Details

LEARNING ANALYTICS

General User Data



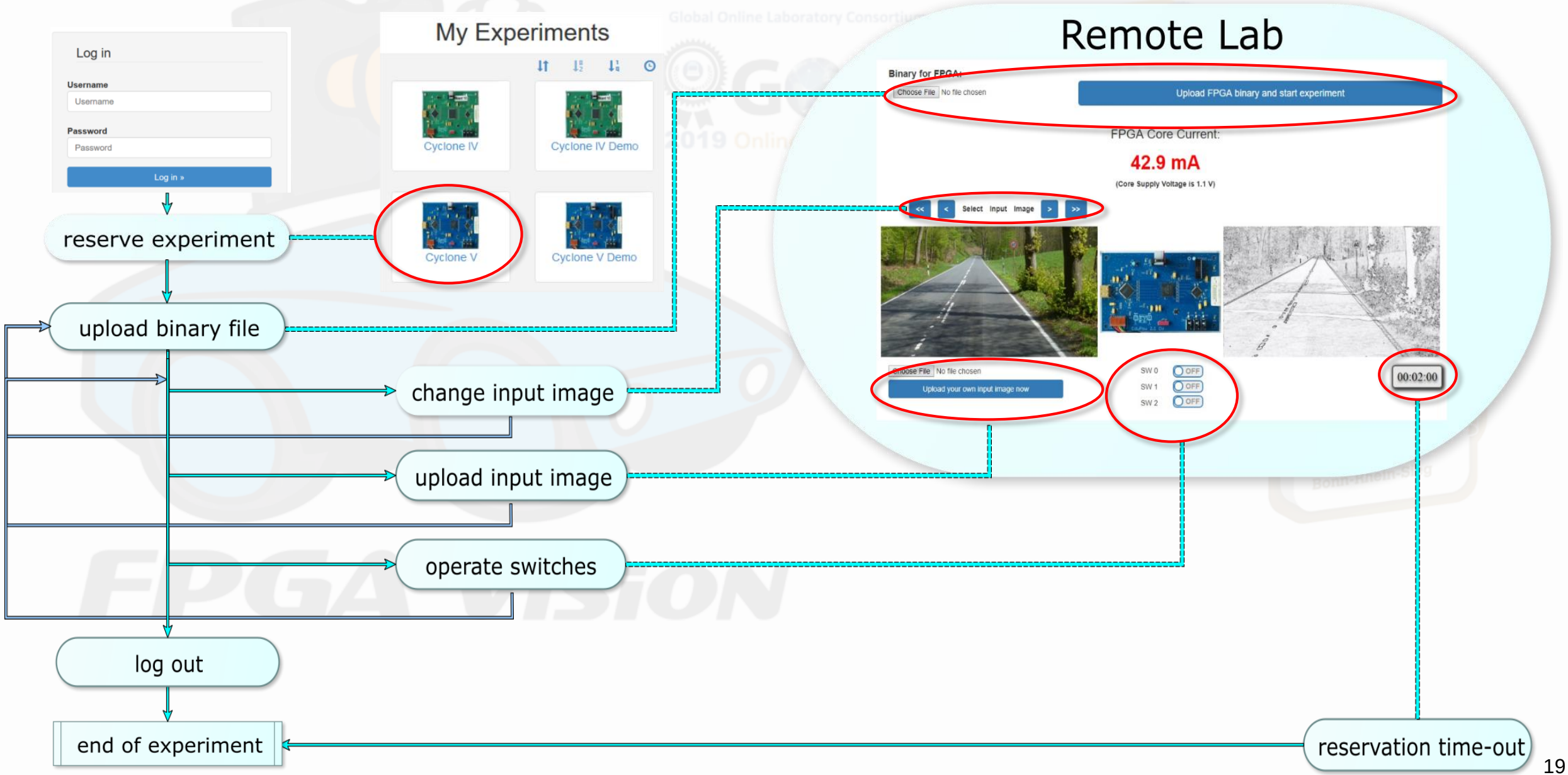
User	Experiment	Start date	End date	Origin	Coord address	Details
	Cyclone V@FPGA experiments	2019-08-06 21:54:50	2019-08-06	202.3.77.	Cyclone_V:laboratory1@core_host	Details
	Cyclone V Demo@FPGA experiments	2019-0 21:52:				ails
	Cyclone V Demo@FPGA experiments	2019-0 21:50:				ails
	Cyclone V@FPGA experiments	2019-0 17:41:				ails
	Cyclone IV@FPGA experiments	2019-0 17:41:				ails
	Cyclone IV@FPGA experiments	2019-0 17:28:				ails
	Cyclone IV@FPGA experiments	2019-0 17:22:				ails
	Cyclone V@FPGA experiments	2019-0 16:32:				ails
	Cyclone V@FPGA experiments	2019-0 16:26:				ails
	Cyclone V@FPGA experiments	2019-0 16:21:				ails
	Cyclone V Demo@FPGA experiments	2019-0 15:54:				ails
	Cyclone V@FPGA experiments	2019-0 15:53:				ails
	Cyclone IV Demo@FPGA experiments	2019-0 15:52:				ails

Details

Login	
Full name	
Experiment	Cyclone V@FPGA experiments
Start date	2019-08-06 21:54:50
End date	2019-08-06 21:56:32
Origin	202.3.77
Device	Cyclone_V:laboratory1@core_host
Web browser	Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/75.0.3770.142 Safari/537.36
Mobil	False
Facebook	False
Language	en
Referer	https://fpga-vision-lab.h-brs.de/weblab/web/pub/fpgavision_CV.html?locale=en&c=https://fpga-vision-lab.h-brs.de/weblab/labs/FPGA%20experiments/Cyclone%20V/config.json
Server	route1
Reservation identifier	666f71a2-32a7-4bef-b123-550c7e869064
Country	IN
City	Kanpur

- accesses from ≥ 50 countries (status March 2022)

User Activity in a Remote Lab Scenario

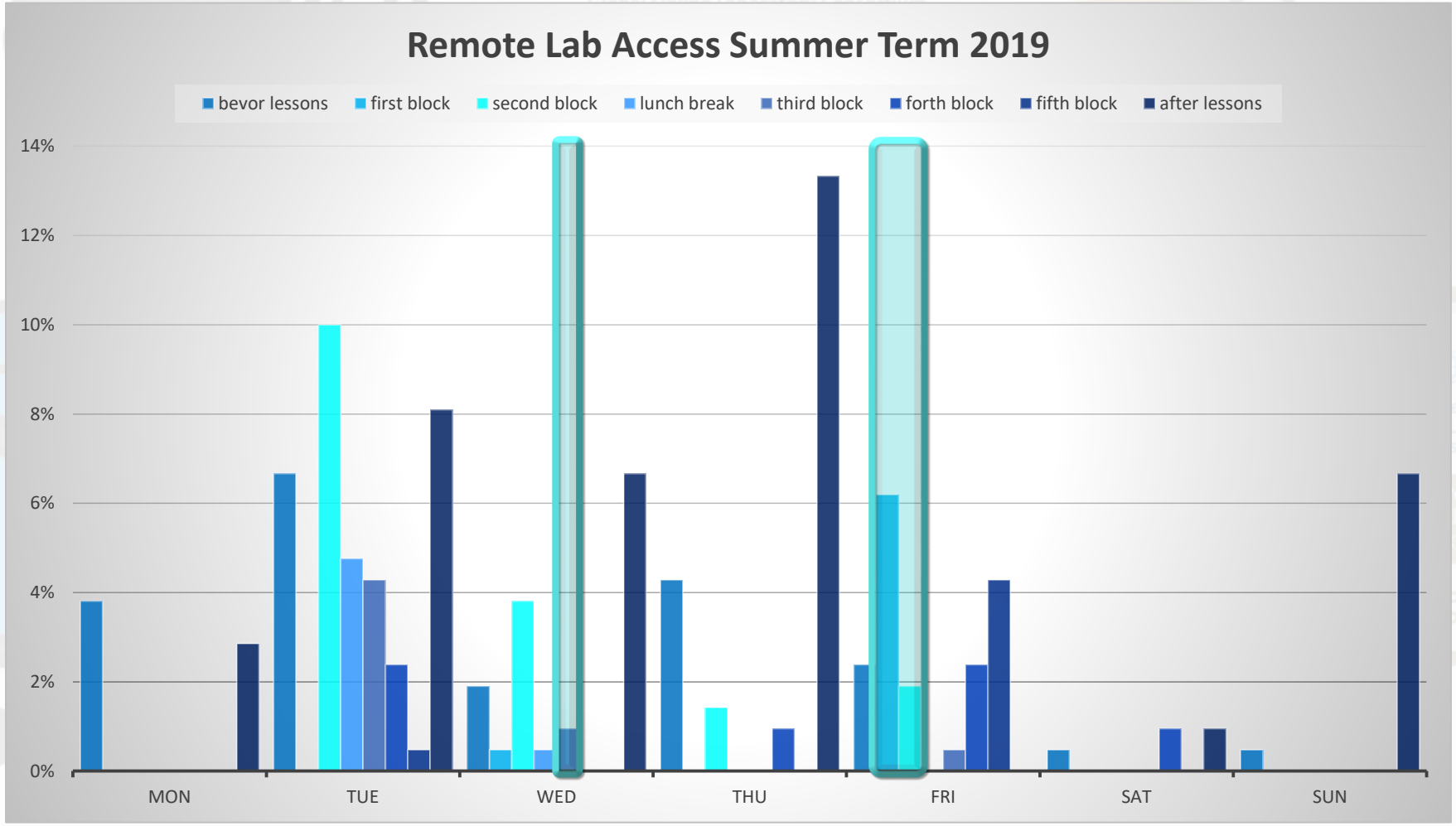


More General User Data

Interactions

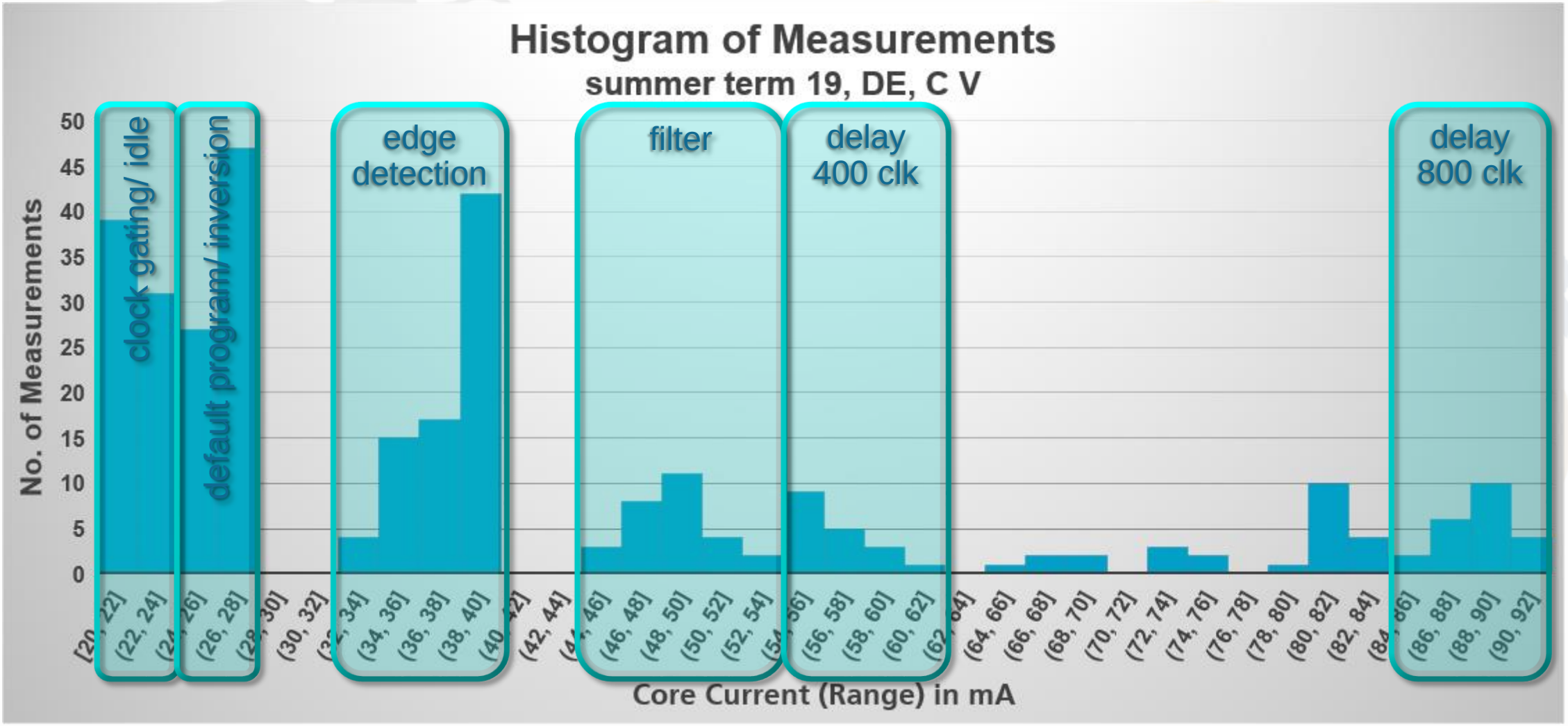
Timestamp before	Timestamp after	Request	Response	Link
2020-03-27 19:34:47.795138	2020-03-27 19:34:47.805783	@@@initial::request@@@	{"back": "https://fpga-vision-lab.h-brs.de/weblab/labs/FPGA%20experiments/C%20V%20all/?finished=true"}	N/A
2020-03-27 19:34:47.795138	2020-03-27 19:34:47.805783	@@@initial::response@@@	CV1	N/A
2020-03-27 19:34:48.058673	2020-03-27 19:34:49.076684	sw0_off	command received switch00	N/A
2020-03-27 19:34:49.078635	2020-03-27 19:34:50.099244	sw1_off	command received switch10	N/A
2020-03-27 19:34:50.100094	2020-03-27 19:34:51.117394	sw2_off	command received switch20	N/A
2020-03-27 19:34:51.118612	2020-03-27 19:34:52.144532	image_home	command received img_home	N/A
2020-03-27 19:35:00.243167	2020-03-27 19:35:00.260547	None (<file not stored>)	Your bit file is transfered...	Download
2020-03-27 19:35:00.307408	2020-03-27 19:35:00.886652	program	An Error (3) occured!! Please be sure to chose the appropriate bit-file for the Cyclone V (5CEBAA2F17C6N)	N/A
2020-03-27 19:35:16.339341	2020-03-27 19:35:16.397050	bit_file.sof (<file not stored>)	Your bit file is transfered...	Download
2020-03-27 19:35:16.442392	2020-03-27 19:35:21.464961	program	Done	N/A
2020-03-27 19:35:22.722767	2020-03-27 19:35:22.918895	update	Image update processed	N/A
2020-03-27 19:35:22.965646	2020-03-27 19:35:24.295887	measure	50.44 mA	N/A
2020-03-27 19:37:49.096090	2020-03-27 19:37:59.192677	@@@finish@@@	None	N/A

User Activity



⇨ students exploit the remote lab to prepare and finish their experiments

System Response



- measurement data shows variety of experiment types

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Technical Data and Results

The FPGA Vision Remote Lab

- online since Jan. 2018
- availability over 99.75 %
- more than 10 000 experiments performed (total)
- analyzation of over 950 experiments for learning analytics

⇨ evaluation results show students' acceptance of the remote lab

⇨ log in data shows the remote lab's usage in addition to lab hours

⇨ measurement results show the type of experiments performed

FPGA Vision

Visit us at:
https://www.h-brs.de/fpga-vision-lab