Enhancing Accessibility for Real-Time Remote Laboratories: A Web-Based Solution with Automated Validation and Access Control

Boris Pedraza, Alex Villazón, Omar Ormachea
Universidad Privada Boliviana (UPB)

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Presentation Outline

Remote laboratories

Proposed solution *“BridgeServer”*

Real use case

Conclusions

Acknowledgments

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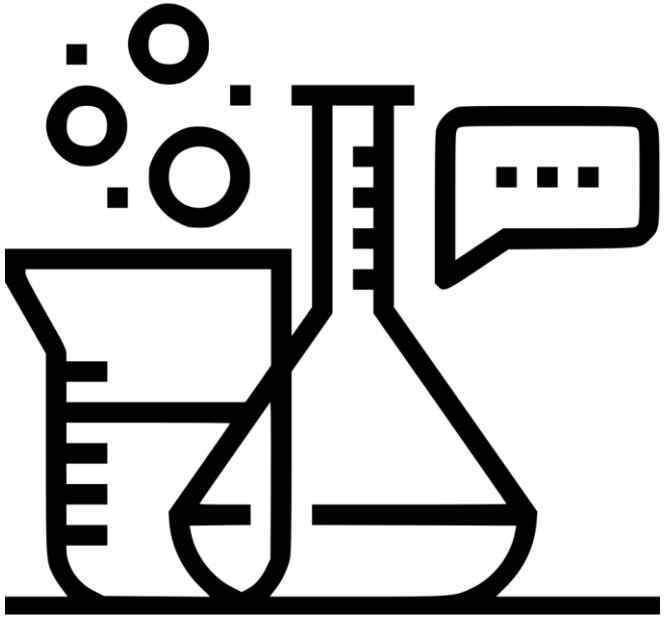
Remote laboratories

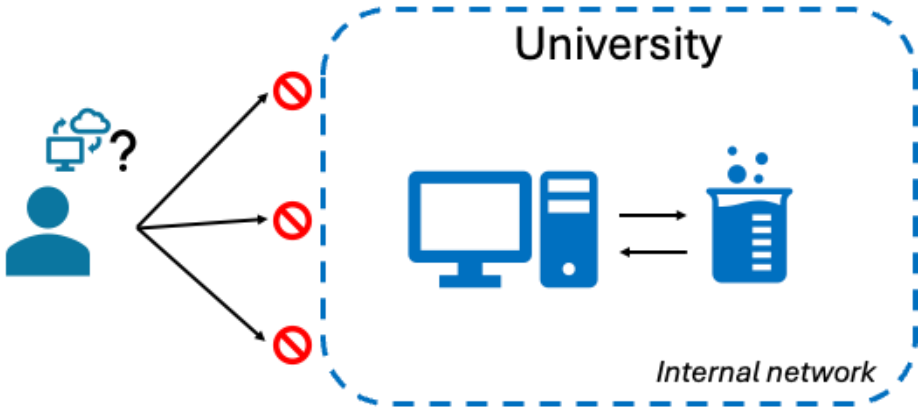
Background



- Use of remote laboratories as a tool in the current education paradigm.
- Students can now remotely interact with laboratories in real time.
- Multiple benefits like cost savings, accessibility and flexibility.

Main challenge

- Various laboratories use an already well defined architecture to work (e.g. SCADA systems running on Windows Operating System only)
- Use of a control software to manage the laboratory within a internal network



How grant access to students?

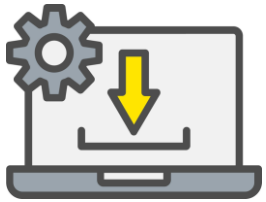
Current approaches

Use of remote desktop solutions

TeamViewer AnyDesk

Remotely connect to the computer with the control software

Use of a client control software



Interact with the laboratory using a client control software

Current approaches shortcomings

01 Selective accessibility

02 Manual supervision is mandatory

03 No automated time control

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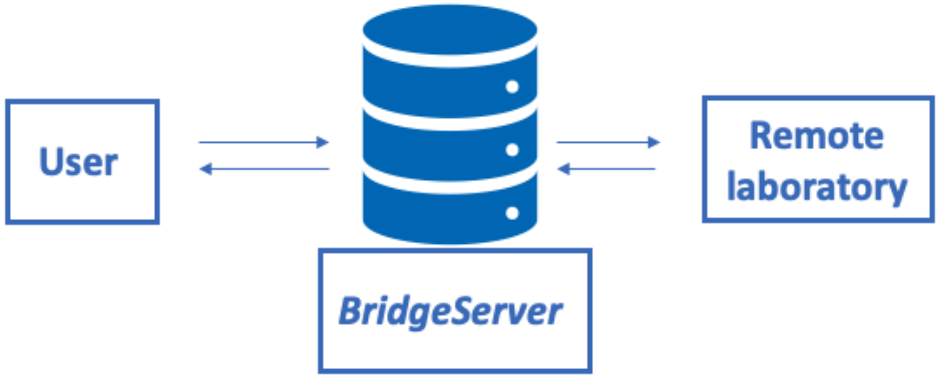
Proposed solution *“BridgeServer”*

Overview

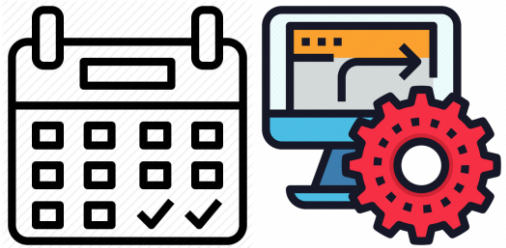
- “BridgeServer” is a tiny web server that creates a remote session environment.
- It acts as a gateway.



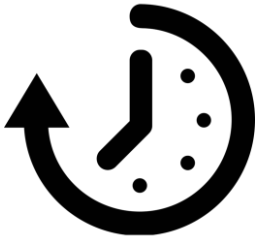
Core features

Web based (Serves a webpage)

Integrated with a booking system



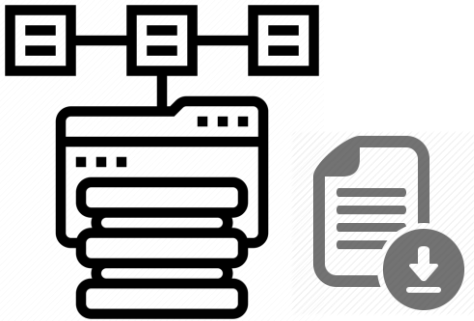
Automated time control



No password sharing

Additional features

File download of specific path location



Live video streaming

Key technologies

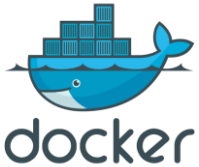
noVNC

Tight VNC

Node js

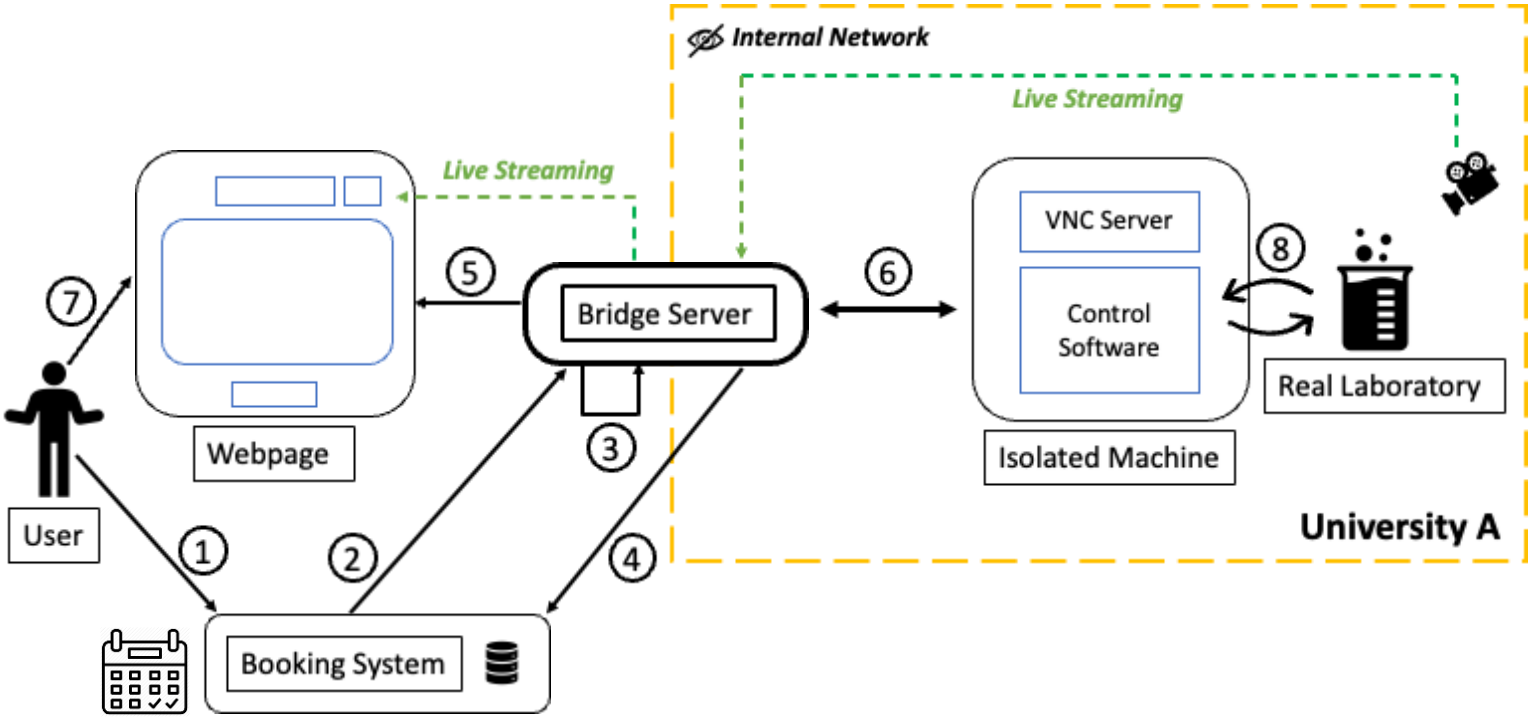
Remote session environment

Nginx



Docker

Architecture and workflow



Demo

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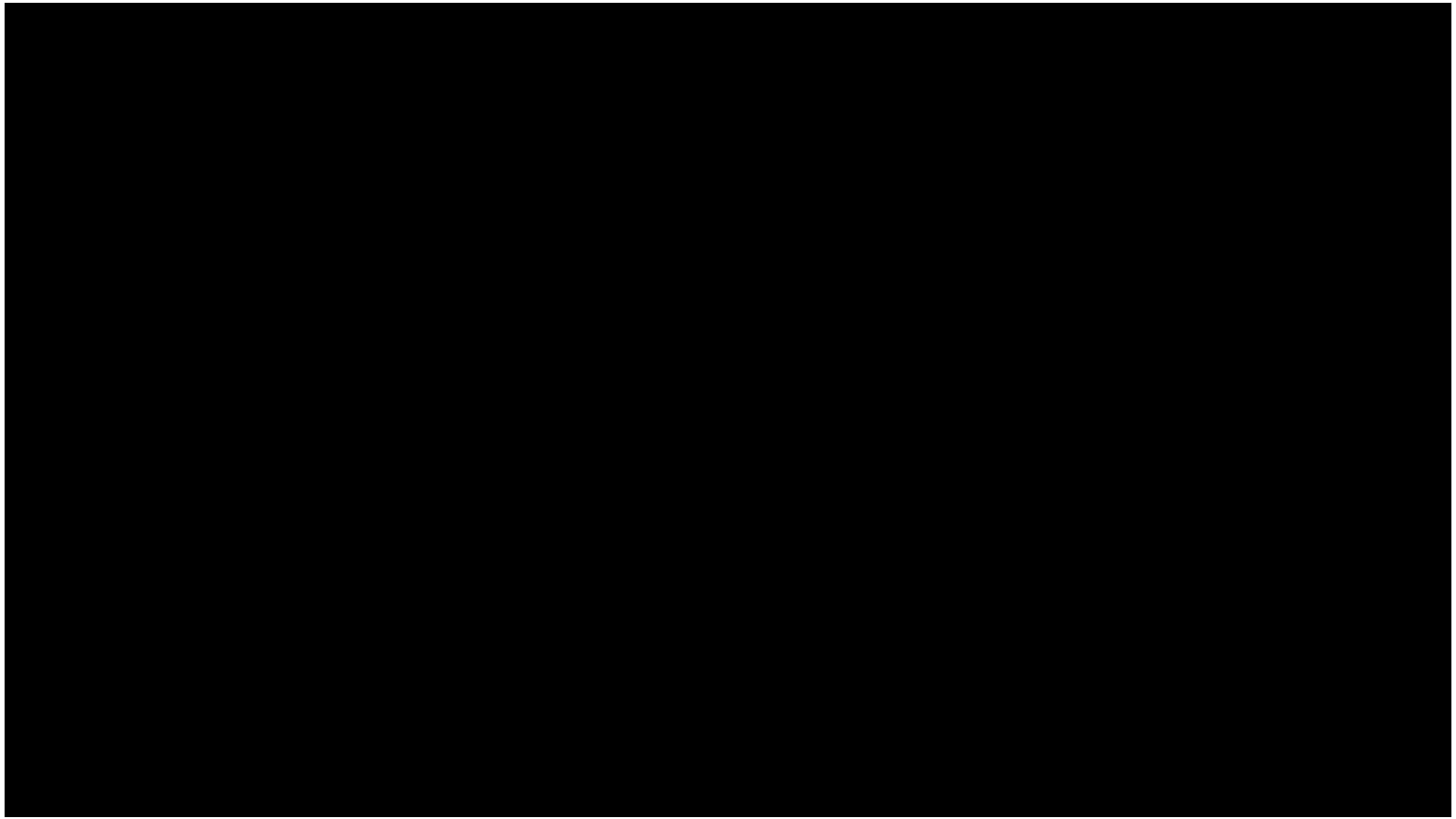

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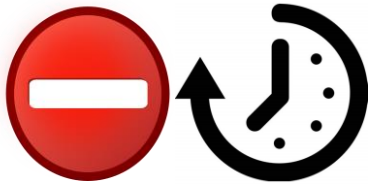
Real use case

Collaborating with the University of São Paulo (USP)

Use of the “BridgeServer” to enhance the USP’s Refrigeration and Air Conditioning System Remote Laboratory.

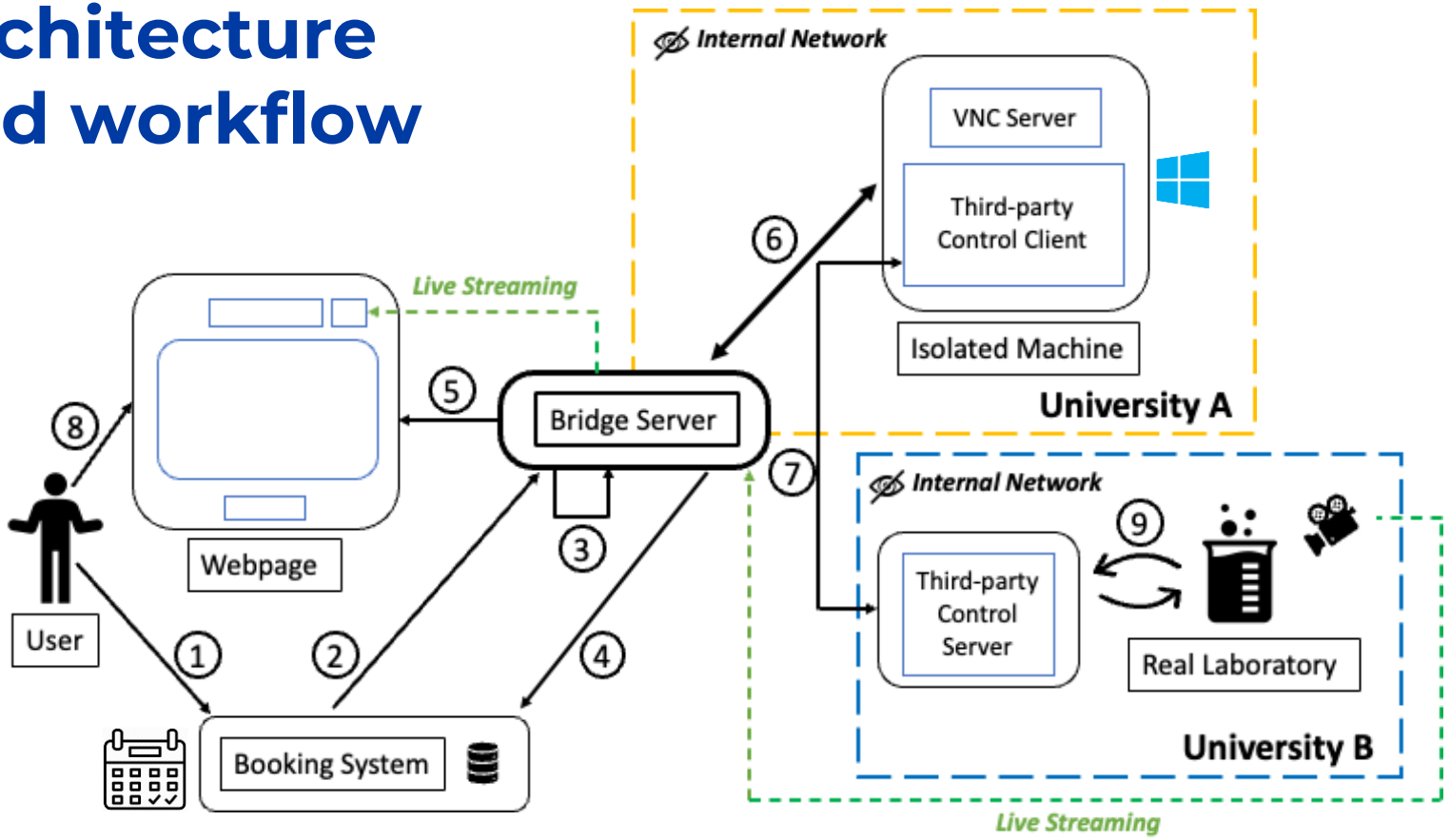
Prior implementation

Control software installation dependent to the OS and the browser



No sessions and time control automation

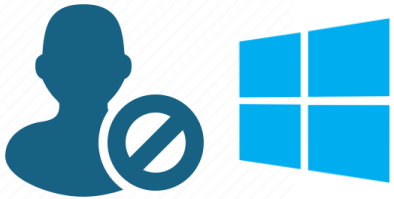
Architecture and workflow



Security measurements

Protection of the isolated machine

- Students have full control over the Windows computer without supervision.
- To solve this issue:
  - Automate the installation and initialization of the control software.
  - Restrict the Windows **user** so it can only interact with the control software (Disable multiple Windows functionalities that may be subject to bad practices)



Solution showcase

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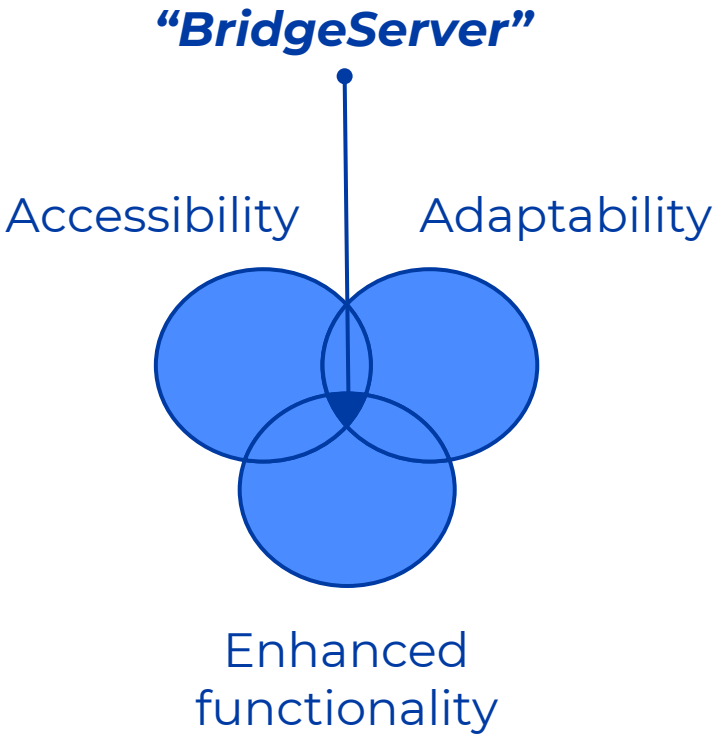
Conclusions



- Our solution overall improves remote laboratories via a secure and user-friendly web page.
- Multiple features to improve the interaction student-laboratory.
- Solution tested within an international remote laboratory network (within the Explore Energy Digital Academy - EEDA)
- Currently being used in multiple countries (Brazil, Bolivia, Cuba and Sri Lanka)

https://github.com/eubbc-digital/bridgeserver

Acknowledgements

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Thank you