8th International Conference on Frontiers of Computing :
Theory and Applications (FICTA 2020)

Conceptualization and Design of Remotely Accessible Hardware Interface (RAHI) Lab

Shivam Mahesh Potdar
Vanshika Gupta
Pruthviraj Umesh
K V Gangadharan

National Institute of Technology Karnataka (NITK), Surathkal
Centre for System Design (CSD)

4 January 2020

8th International Conference on Frontiers of Computing : Theory and Applications (FICTA 2020)

Outlines

Introduction

Why?

Motivation

1. Lack of practical exposure in students undergoing technical courses
2. Unavailability of high-end embedded systems development kits in schools and colleges
3. High initial investment for high-end hardware
4. Low accessibility to younger students
5. Simulation limited by ideal case results and not reconfigurable

Motivation

1. Lack of practical exposure in students undergoing technical courses
2. Unavailability of high-end embedded systems development kits in schools and colleges
3. High initial investment for high-end hardware
4. Low accessibility to younger students
5. Simulation limited by ideal case results and not reconfigurable

Motivation

1. Lack of practical exposure in students undergoing technical courses
2. Unavailability of high-end embedded systems development kits in schools and colleges
3. High initial investment for high-end hardware
4. Low accessibility to younger students
5. Simulation limited by ideal case results and not reconfigurable

Motivation

1. Lack of practical exposure in students undergoing technical courses
2. Unavailability of high-end embedded systems development kits in schools and colleges
3. High initial investment for high-end hardware
4. Low accessibility to younger students
5. Simulation limited by ideal case results and not reconfigurable

Motivation

1. Lack of practical exposure in students undergoing technical courses
2. Unavailability of high-end embedded systems development kits in schools and colleges
3. High initial investment for high-end hardware
4. Low accessibility to younger students
5. Simulation limited by ideal case results and not reconfigurable

Motivation

1. Lack of practical exposure in students undergoing technical courses
2. Unavailability of high-end embedded systems development kits in schools and colleges
3. High initial investment for high-end hardware
4. Low accessibility to younger students
5. Simulation limited by ideal case results and not reconfigurable

State of the art

In electronics hardware education

Literature Survey and Proposed Solution

- Simulation used as a medium by Diaz et al and Kay et al.
- Macias et al have proposed DAQ system with proprietary GUI
- Chen et al have built a system with sandboxing through simulation for HDL code on hardware.
- Real-time visual feedback, open source hardware and software, sandboxing and reconfigurability are expected features.
- Prototype system with those points in mind built, with sensors and actuators connected to Raspberry Pi that communicates with a server, allowing remote code execution to user with real-time visual and textual feedback.

Literature Survey and Proposed Solution

- Simulation used as a medium by Diaz et al and Kay et al.
- Macias et al have proposed DAQ system with proprietary GUI
- Chen et al have built a system with sandboxing through simulation for HDL code on hardware.
- Real-time visual feedback, open source hardware and software, sandboxing and reconfigurability are expected features.
- Prototype system with those points in mind built, with sensors and actuators connected to Raspberry Pi that communicates with a server, allowing remote code execution to user with real-time visual and textual feedback.

Literature Survey and Proposed Solution

- Simulation used as a medium by Diaz et al and Kay et al.
- Macias et al have proposed DAQ system with proprietary GUI
- Chen et al have built a system with sandboxing through simulation for HDL code on hardware.
- Real-time visual feedback, open source hardware and software, sandboxing and reconfigurability are expected features.
- Prototype system with those points in mind built, with sensors and actuators connected to Raspberry Pi that communicates with a server, allowing remote code execution to user with real-time visual and textual feedback.

Literature Survey and Proposed Solution

- Simulation used as a medium by Diaz et al and Kay et al.
- Macias et al have proposed DAQ system with proprietary GUI
- Chen et al have built a system with sandboxing through simulation for HDL code on hardware.
- Real-time visual feedback, open source hardware and software, sandboxing and reconfigurability are expected features.
- Prototype system with those points in mind built, with sensors and actuators connected to Raspberry Pi that communicates with a server, allowing remote code execution to user with real-time visual and textual feedback.

Literature Survey and Proposed Solution

- Simulation used as a medium by Diaz et al and Kay et al.
- Macias et al have proposed DAQ system with proprietary GUI
- Chen et al have built a system with sandboxing through simulation for HDL code on hardware.
- Real-time visual feedback, open source hardware and software, sandboxing and reconfigurability are expected features.
- Prototype system with those points in mind built, with sensors and actuators connected to Raspberry Pi that communicates with a server, allowing remote code execution to user with real-time visual and textual feedback.

Literature Survey and Proposed Solution

- Simulation used as a medium by Diaz et al and Kay et al.
- Macias et al have proposed DAQ system with proprietary GUI
- Chen et al have built a system with sandboxing through simulation for HDL code on hardware.
- Real-time visual feedback, open source hardware and software, sandboxing and reconfigurability are expected features.
- Prototype system with those points in mind built, with sensors and actuators connected to Raspberry Pi that communicates with a server, allowing remote code execution to user with real-time visual and textual feedback.

Technical Details of Implementation

Figure: Flowchart of the System

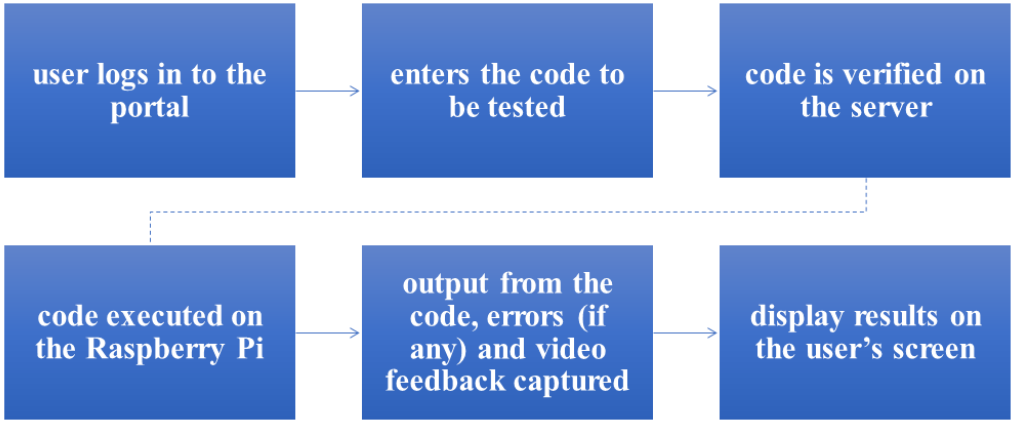
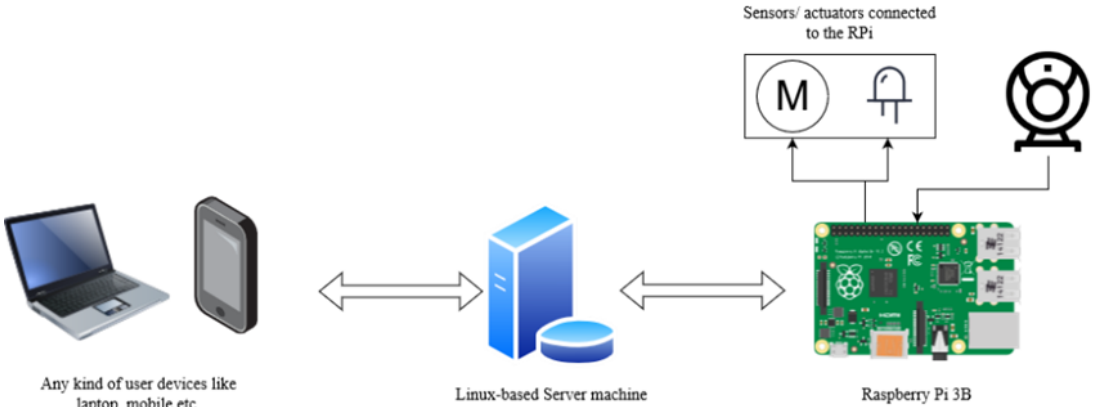


Figure: Block Diagram



Components

1. Server
   - Linux based
   - Independent of RPi
   - Database
2. Raspberry Pi and Hardware
   - Sensors and Actuators
   - Camera
   - Internet Connection

Components

3. Web Application
   - User Management
   - Code Editor
   - Sandboxing
   - Code Execution
   - Database and Logs

Live Demo

Inferences

Positives

- Anytime anywhere access
- Real time video feedback
- Low investment
- Safety of high end hardware
- Use of independent server

Future Scope

- Latency
- Automated checking
- Collaborative work
- Extension to other platforms

Try it out!

Questions/ Feedback

Thank You !

References

Chen, Yongqiang, Cheng Bin Quan, and Yuchao Gao. "Programming online judge system". In: *Proceedings - 2016 International Conference on Computational Science and Computational Intelligence, CSCI 2016*. 2017. ISBN: 9781509055104. DOI: 10.1109/CSCI.2016.0064.

Ciencias, Aprendizaje D E L A S, Tecnologías E Ingenierías En, and Mg Carlos Alberto. "ARDUINO AS A TOOL FOR THE IMPROVEMENT OF THE TEACHING –". In: *Quid* (2015).

Cuartielles, David. *Opensource hardware and education*. 2015. ISBN: 9783319184241.

Díaz, Gabriel et al. "Remote electronics lab within a MOOC: Design and preliminary results". In: *Proceedings - 2013 2nd Experiment@ International Conference, exp.at 2013*. 2013. ISBN: 9781479927418. DOI: 10.1109/ExpAt.2013.6703036.

Galadima, Ahmad Adamu. "Arduino as a learning tool". In: *Proceedings of the 11th International Conference on Electronics, Computer and Computation, ICECCO 2014*. 2014. ISBN: 9781479941063. DOI: 10.1109/ICECCO.2014.6997577.

Guo, Philip. *Why Python is a great language for teaching beginners in introductory programming classes*. 2007. URL: http://pgbovine.net/python-teaching.htm.

Kay, Jennifer S. and Tom McKlin. "The challenges of using a MOOC to introduce "Absolute beginners" to programming on specialized hardware". In: *L@S 2014 - Proceedings of the 1st ACM Conference on Learning at Scale*. 2014. DOI: 10.1145/2556325.2567886.

Macías, Manuel E. and Israel Méndez. "eLab - Remote electronics lab in real time". In: *Proceedings - Frontiers in Education Conference, FIE*. 2007. ISBN: 1424410843. DOI: 10.1109/FIE.2007.4418154.