Remote Controlled Hybrid Educational Platform: Case Study

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Abstract

This paper presents a remote controlled educational system. This system consists of two subsystems: a videoconference subsystem to present the theoretical part of the course and a practical subsystem to show students the manipulations in real time. The videoconferencing part is based on the open-source tool BigBlueButton, while the second part is based on embedded electronics. A detailed description of the merger of the two systems is presented in this work.

Keywords: Technical teaching, bigbluebutton, Remote lab, hybrid educational system, e-learning

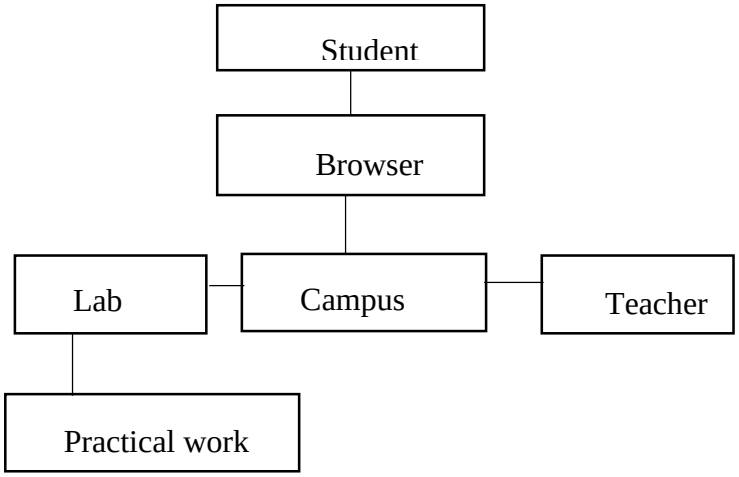
1. Introduction

In recent years, several distance learning architectures have been developed to improve the existing conventional system (De Lima et al, 2016) (Tawfik et al, 2012). Video conferencing systems, one of the solutions that allows you to teach a theoretical distance learning course for students in any location in the world (Vasconcelos et al, 2017). This teaching technique has several advantages, namely that the student has the opportunity to see the teacher's facial expressions, which gives the impression that they are in the same place, in addition a remarkable time saving in this system since students no longer spend much time to move around, this factor also, perhaps seen from an economic angle, whose travel expenses are not incurred by the student to get to the classroom (Han, 2018). Several free and open-source videoconferencing solutions have been deployed, in the literature we find that bigBlueButton (BBB) (Han, 2018) is the most used by researchers to test their hypotheses around the subject of virtual classes. Admittedly, this system is limited in cases where practical demonstration is essential, for example, in automation, electronics, robotics... In this case the teacher needs to make a practical and didactic manipulation in order to demonstrate what they have learned at the theoretical level. Indeed, several researchers have developed remote-controlled practical work laboratories (Malaoui, 2016) (Abouhilal et al, 2016) (Heradio et al, 2016) (Abouhilal et al, 2017). The latter allows remote physical devices to be manipulated in real time because of the easy-to-use interfaces, and that in a scenario separate from the theoretical course. This motivated us to develop a hybrid system that combines videoconferencing and practical work laboratories. This work gives a description of the use of this system in a renewable energy course.

2. Materials and Methods

2.1 Technology background

Figure 1: Figure description (TNR 10pt., centered, italics)



Distance students can attend the theoretical course presented by the teacher via the videoconferencing system hosted on the institution's server. The teacher can connect to the laboratory server to start a session of practical remote manipulation when explaining it. In addition, he has the possibility to give a student the right to demonstrate, the latter will share his BigBlueButtion screen and connect to the laboratory server to remotely manipulate the practical work as shown in Fig.1.

2.2 Pedagogical use

The use of this hybrid system is gradually being implemented in 2 stages. In the first step, the teacher presents the theoretical course with videoconferencing until it reaches the part where there is a need to present practical experience. In this second step, he connects to the interface of the practical manipulation, then explains to the students the different components of the interface. Thereafter, he or she conducts the experiment and interprets the results obtained.

Figure 2: Bigbluebutton interface

2.3 Description of the system

2.3.1 Platform

In this section we will describe the developed hybrid system, which is in this case used for teaching a renewable energy course with experience in measuring the characteristics of a photovoltaic solar panel, a detailed description of this manipulation is present in our previous work.

2.3.2 Hardware and software

- Hardware

Acquisition card (Arduino uno)

Raspberry Pi

Server Lab

Camera video

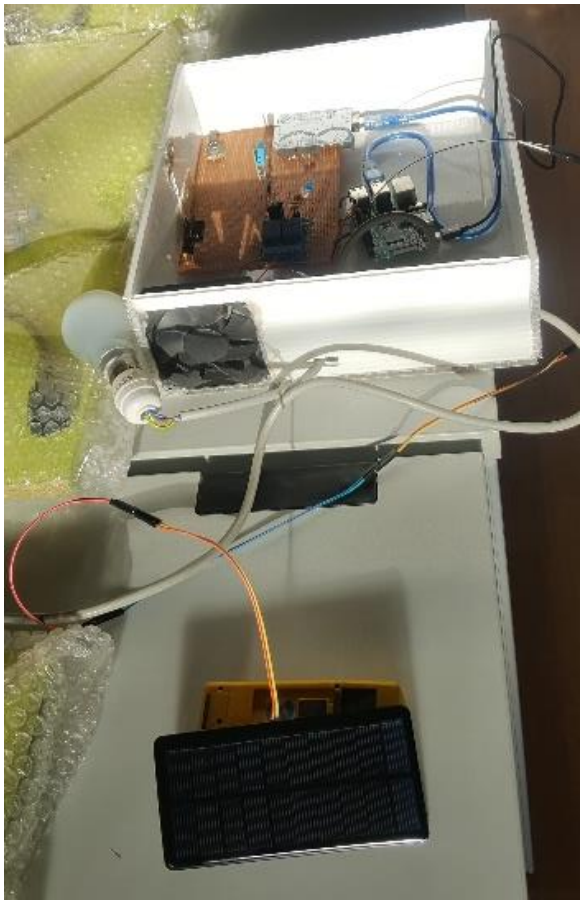
Solar panel

- Software

MATLAB

Arduino 1.6.5

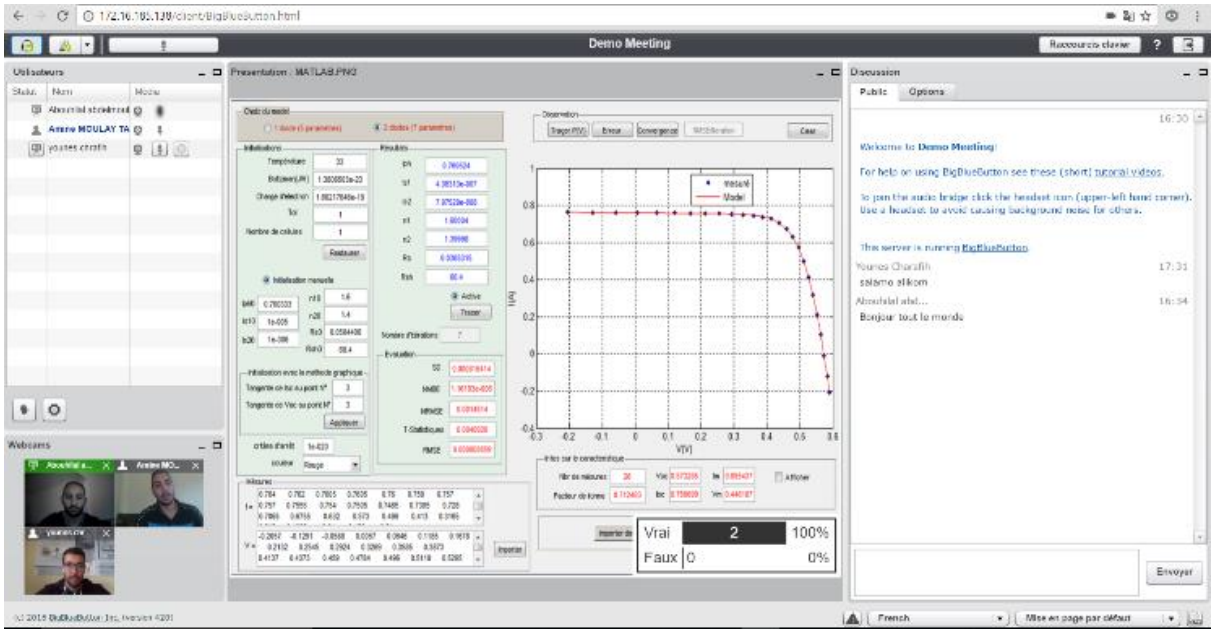
Figure 3: Developed practical work



2.3.3 User interface

The user interface of the developed system is customized as a MATLAB application that contains an algorithm for extracting the characteristics of a solar panel. Using this interface, the teacher and students can trace the characteristic I = f(V) with the parameters measured in real time via the practical work acquisition card as shown in fig.3

Figure 4: Practical work through BBB demonstration



3. Results and discussion

This technique uses a hybrid system for distance learning, teaching technical disciplines that require experimentation. Unlike the traditional method of courses which depends on the presence of the teacher and students in the same room for a theoretical course and then, they must move to the room of practical work with all the risks that come into play when using high-risk equipment. Indeed, this system has shown several advantages on the scale:

- Pedagogical: the teacher can clarify phenomena encountered during the course with real time experience and simultaneously with the theoretical course.
- Logistics: the administrative staff would no longer need to schedule classrooms for hundreds of people.
- Economic: Institutions in developing countries will no longer need to spend and invest in expensive machinery and equipment for practical work due to the feasibility of easily replicating manipulations. On the other hand, students and teachers no longer had to pay travel expenses to the institution.
- Social: people with reduced mobility can also benefit from this system as they can take the course from home.
- Time: this system saves a considerable amount of time thanks to its availability 24 hours a day, 7 days a week.

4. Conclusion

Distance learning systems are becoming more and more widespread on the Internet. Remote-controlled practical work laboratories and videoconferencing environments have been developed in our previous work. In this work a hybrid system has been developed and studied to benefit from the advantages of both techniques. This system has shown several advantages as mentioned in the discussion, whether at the economic, social, logistical or pedagogical level.

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