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Remote Laboratory for Renewable Energies

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Abstract: *We have set up a remote renewable energy laboratory called REMOTE LAB. The laboratory offers remote learners the opportunity to do practical work at a distance in the field of renewable energy. The implementation of this laboratory represents a pedagogical innovation and makes it possible to develop collaborative synchronous work; students and teachers can indeed control together laboratory equipment and interact simultaneously. After describing this experimental training method, we will give an example of manipulation. Some indicators will be set up to study the pedagogical effectiveness of this laboratory through feedback.*

Keywords *- Distance learning, virtual laboratory, remote practical works, virtual classroom, collaborative working.*

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I. Introduction

We have set up a pedagogical laboratory for practical work on renewable energies, in the same context a Moodle platform has also been installed containing many pedagogical functionalities (ergonomic interface, dashboard with student/teacher view, calendars, internship follow-up, wiki, forums, etc.) and linked to a back office accessible to the pedagogical/administrative team.

The e-learning laboratory and platform, combined with the expertise of lecturer researchers in the field of renewable energies, has provided the favorable ground for the establishment of three training courses that prepare specialized technicians, middle managers and engineers in the field of renewable energies.

Within the framework of this project, a pedagogical laboratory for practical work on renewable energies has been equipped with electronic tools and remote maintenance software enabling students to carry out remote TPs (RemoteLab), which represents an important pedagogical innovation. The importance of this solution lies in the synergy between teaching and research and in the combination of different types of software/material tools (ICT and renewable energy), leading to the implementation of new uses:

- ICT tools: interactive whiteboards, virtual classrooms, application servers, remote control, etc.
- Renewable energy business tools; management.
-Remote control of an electronic device with a remote SCADA (virtual) interface at the Teamviewer student's home.
- All this with "synchronous" supervision by the teacher (virtual TP room with a video camera).
-The possibility of recording the session to make it available to absent people (podcasting).

In recent years, the development of open and distance learning (ODL), whether or not leading to a diploma, has accelerated considerably throughout the world. These new training methods correspond to technological revolutions in software (Web 2.0, Web 3.0...) and/or hardware (use of tablets, increasingly powerful servers...). (Leproux et al 2012)

In the field of applied sciences, theoretical skills are systematically accompanied by practical, experimental and manipulative skills that are more difficult to acquire.

However, electronic systems are creating technologies that facilitate access to machines that can be controlled, controlled and ultimately manipulated remotely. Many educational teams around the world are taking advantage of these technological advances to implement virtual experimental laboratories - hardware and software - in order to offer remote labs. (Billaud et al., 2002; Crabeel et al., 2012; Claesson and Hakansson, 2012, Leproux et al 2012)

II. Functional Specification

The establishment of a virtual practical work laboratory requires a combination of human and material resources while meeting the specifications of a set of specifications. These specifications specify the specifications expected from the laboratory and define the various actors, their access and control rights to material resources.

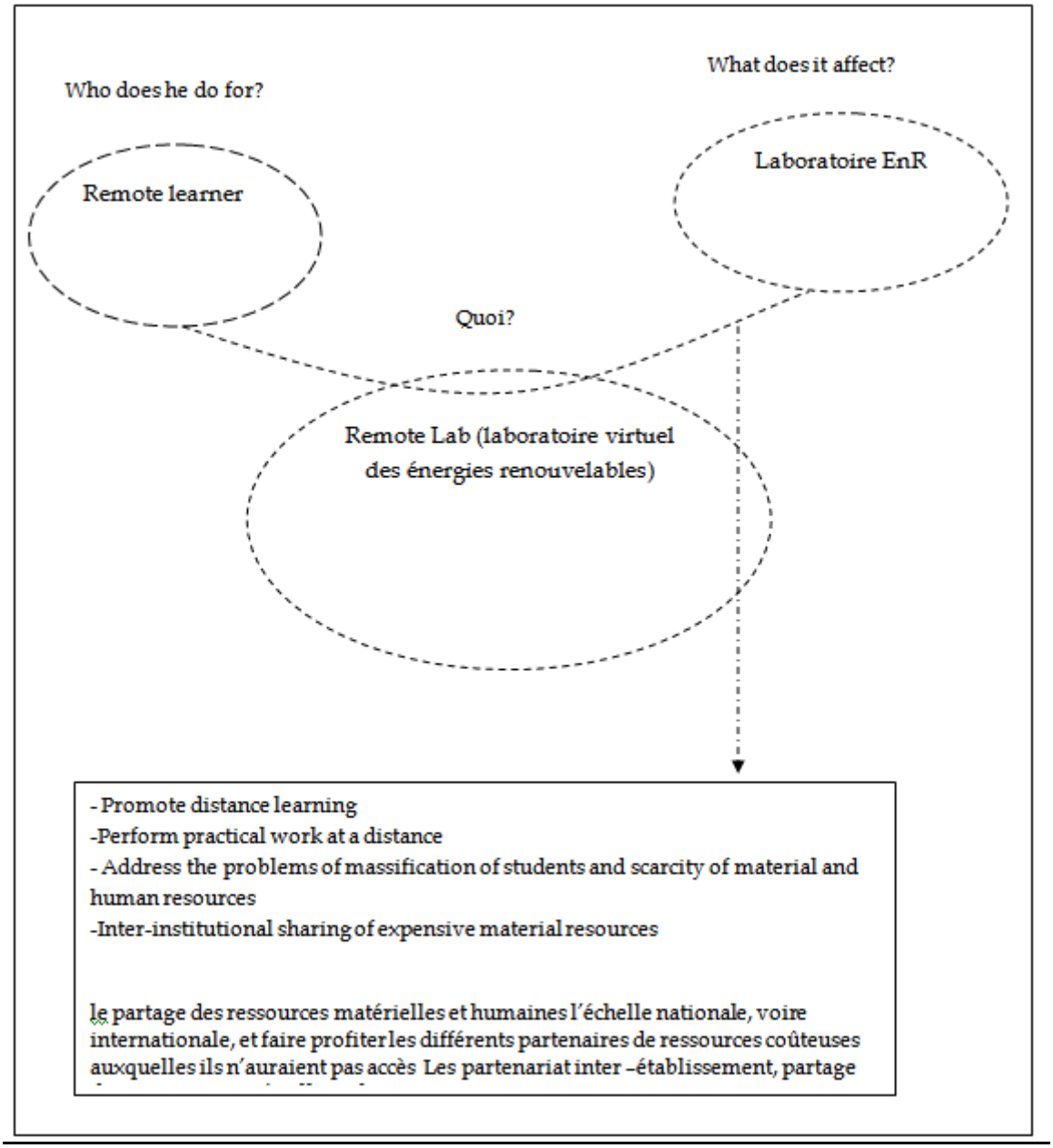

Figure 1 - Functional specifications: "horned beast" diagram

III. Allocations of Resources

3.1 THE HANDLING STATIONS (POST-MANIPULATION)

The pedagogical laboratory for practical work on renewable energies involves several steps: first of all The equipment that will be part of the Remote Lab is equipped with a computer equipped with a control and data acquisition system; abbreviated SCADA (Supervisory, Control, And Data Acquisition) and developed using the LabVIEW (Laboratory Virtual Instrument Engineering Workbench) automation application development environment. This system includes hardware and software components. In general, this type of system offers a wide range of communication possibilities between a local system and remote physical devices via a local or remote network. Locally it allows the use of frame grabbers, serial and parallel links, USB ports to communicate different types of data. The computer then processes this data and presents it in real time.

The equipments concerned are:
a. Solar energy module, Computer controlled

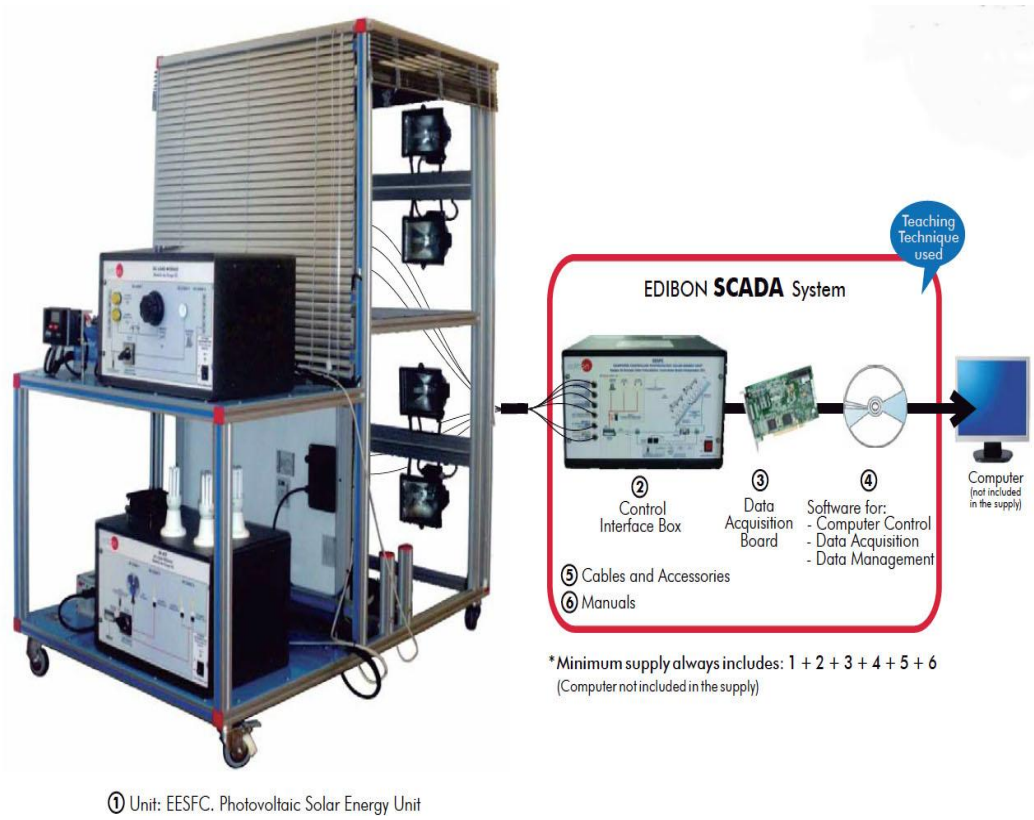

Figure 2 - Solar energy module, Computer controlled

b.Computer-controlled solar thermal energy module

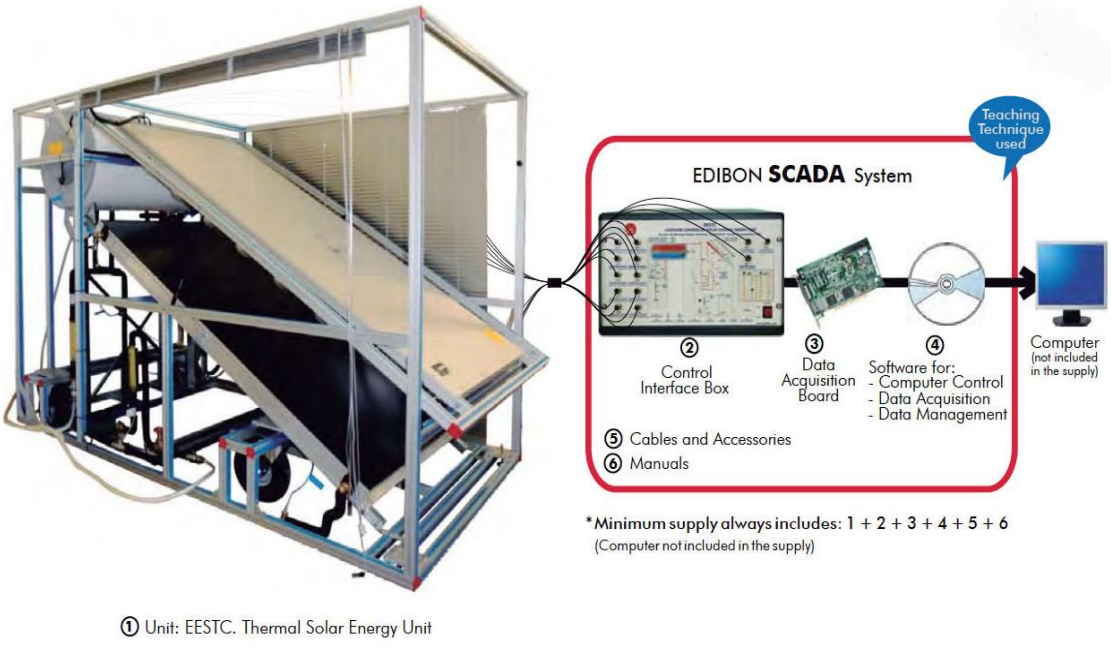

Figure 3 - Computer- controlled solar thermal energy module

c. Wind Energy Module, Computer Controlled

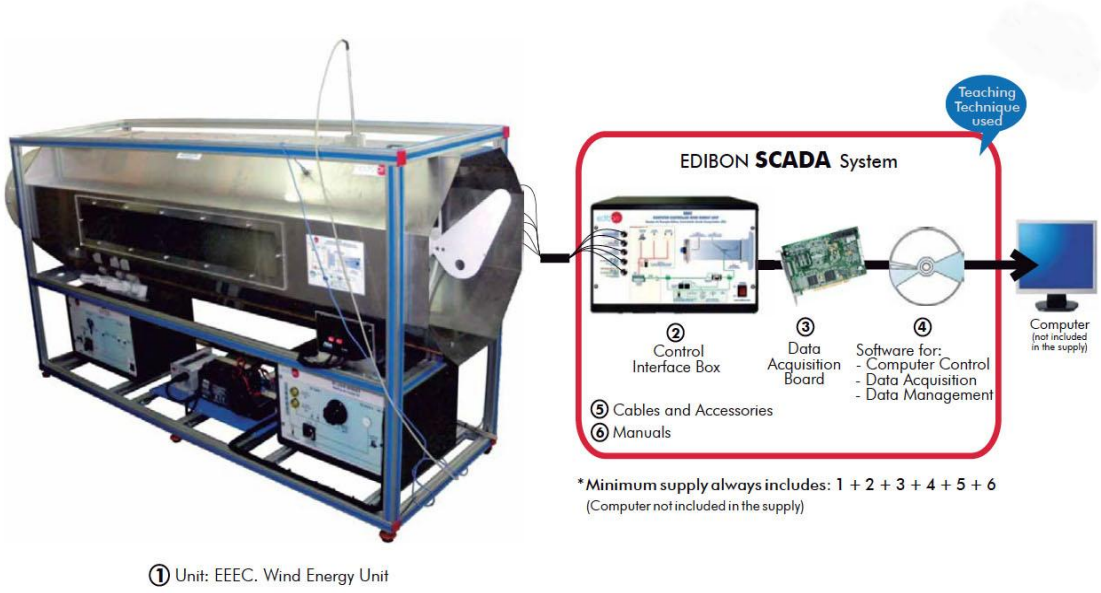

Figure 4 - Wind Energy Module, Computer Controlled

3.2 PRESENTING AGENT

Presenting agent is the remote learner (or work group), he must obviously have a computer equipped with communication tools (camera and microphone) and connected to the Internet.

3.3 ORGANIZING AGENT

For distance education, as in face-to-face teaching, the role of pedagogical supervision remains important, both for the preparation of subjects and working documents and for the supervision and monitoring of the progress of the Tps. The organizing agent can be the teacher, a facilitator or a practical work manager attached to the laboratory, which must obviously have a computer equipped with communication tools (camera and microphone) and connected to the Internet. Its main functions are:

-Planning of working sessions; i.e. the date and number of parallel Tps (google, doodle, etc.)

-Transfer and share working documents (moodle, drive, dropbox, inboxing, etc.)

-Assistance with the installation and configuration of the remote access tool (Cisco, teamviewer, etc.) and communication tools (cameras and microphones).

3.4 REMOTE ADMINISTRATION TOOLS:

A platform for remote access and control of a computer and its operating system in order to perform operations for creating and manipulating work files (e. g. EXCEL file) and particularly to access LabVIEW applications. Several remote administration tools exist:

Mikogo, AMMYYY Adminn, WebEx Free, Chrome Remote Desktop, Ultra VNC, LogMeIn ,ProSplashtop, Join.me, Real VNC, Windows Remote Desktop Connection,.Teamviewer

3.5 OVERVIEW OF THE TEAMVIEWER TOOL

TeamViewer is a proprietary remote maintenance software with remote desktop, remote administration, online conferencing and file transfer functions. TeamViewer can be installed on a computer, although there is the Quick Support version running without installation10.

To connect to another computer, TeamViewer must be running on both machines at the same time. To install TeamViewer, administrator access is required, but once installed, it can be executed by any user. When TeamViewer is launched on a computer, it generates a partner ID and a password (user-defined passwords are also supported). To establish a connection from a local client to a remote host machine, the local operator must communicate with the remote operator by providing his ID and password in the software interface. They can join the meeting using the full version of TeamViewer or by connecting to go.teamviewer.com with the meeting ID. It is also possible to schedule a meeting in advance12.

Our motivation for

- Specifying access and control rights

Organizer: Adding and deleting workgroups; Audiovisual exchange with workgroups; Access to the different maneuvers; Explanation and correction of the maneuvers.
Presenting agent: Audiovisual exchange with organizing agent; Remote access and control of the post manipulation
Manipulator station: Remotely accessible;

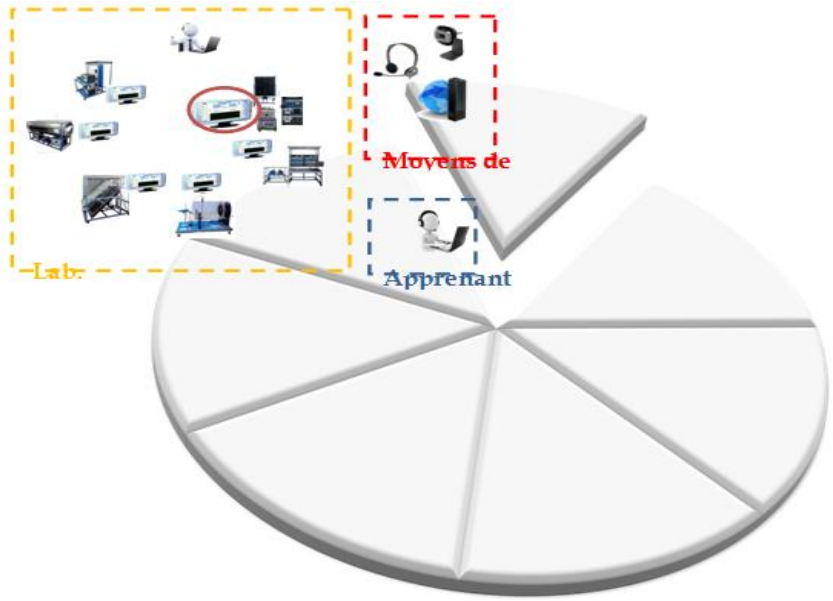

Figure 5 - Human and material resources required to develop Lab-Vi-EnR

IV. Architecture adopted

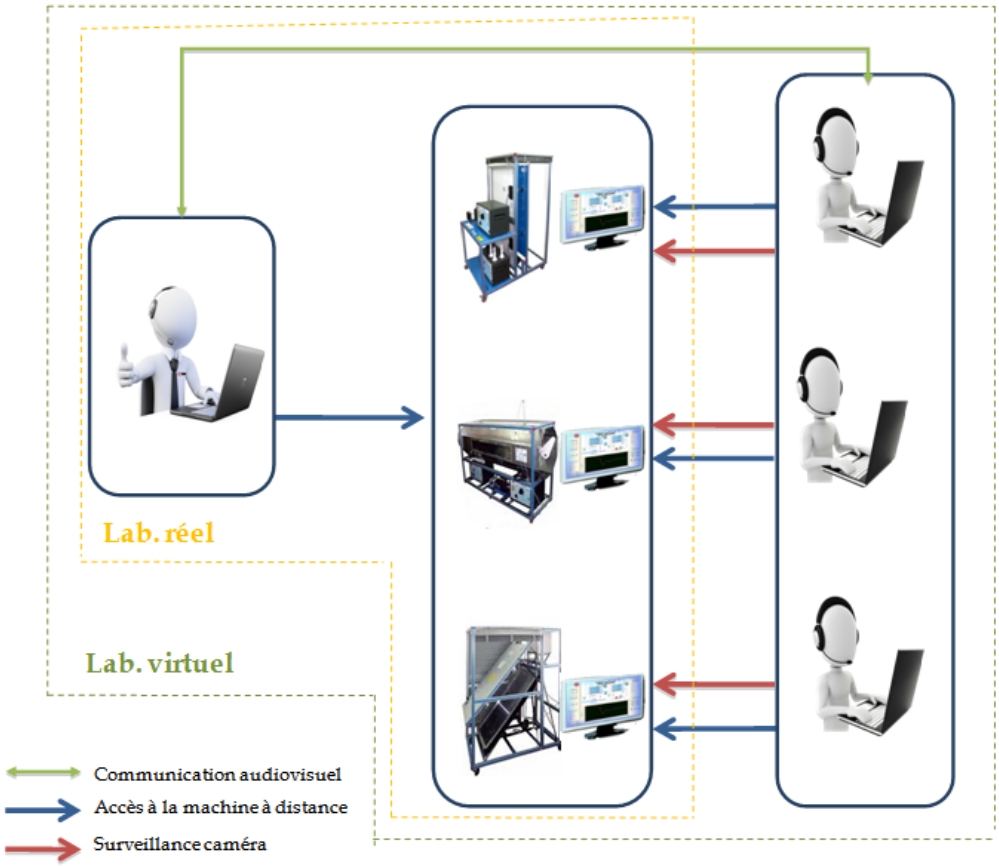

Figure 6 - Architecture du Lab-Vi-EnR

V. Demonstration

In the following we will present, a demonstration of the manipulation of the Wind Energy Module, Computer Controlled remotely.
This demonstration will be illustrated with photo images and screenshots, a video recording will also be provided.

5.1 DESCRIPTION OF THE MANIPULATION POSITION

The Computer Controlled Wind Energy Unit (CCEU) contains a laboratory scale wind generator used to study the conversion of wind kinetic energy into electrical energy and to study the influence of certain factors on this production. The unit consists of:
- Stainless steel tunnel.
- A variable speed axial fan (computer controlled).
- 6-blade wind generator with a capacity of up to 60W.
- Anemometer.
- Speed sensor.
- Voltage gauge (Wattmeter).
- Current control device (Wattmeter).
- The thermocouple temperature sensor type J.
- Regulator.
- Control system (SCADA).
- A DC charging module contains DC lamps, rheostat, DC motor, load selectors and switches to select the type of charge.

Figure 7 - Post manipulation

Figure 8 - Administrator agent screen

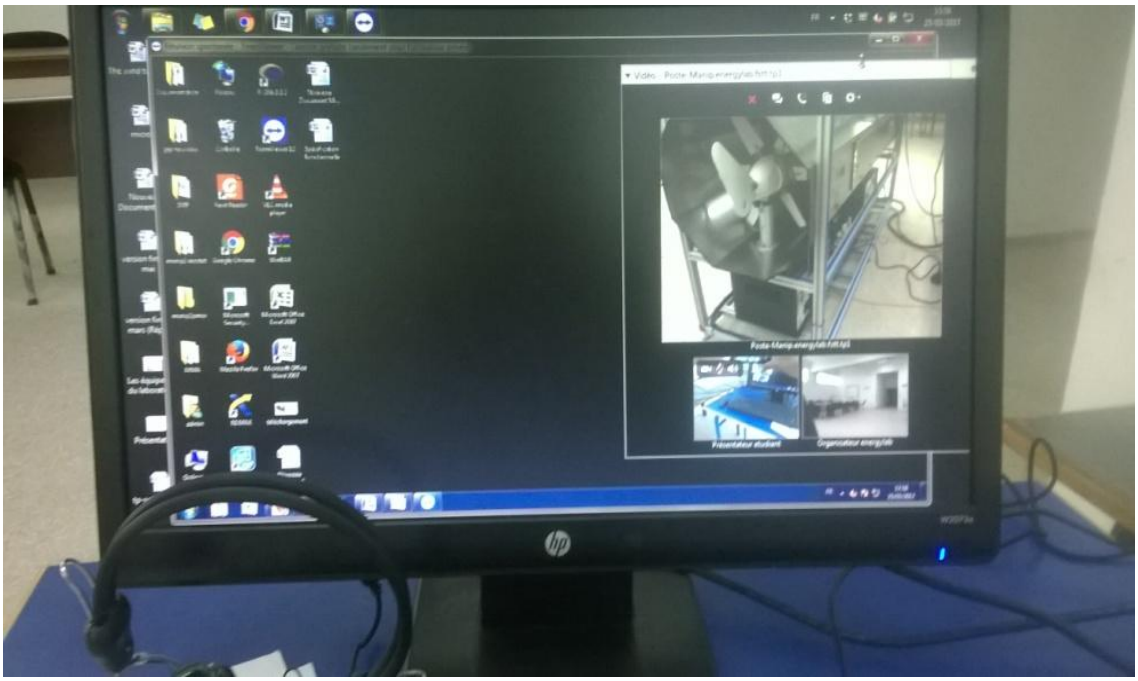

Figure 9 - Presenting agent screen

5.2 THE WORK TO BE DONE

As explained above, the presenter should first receive the working document. Here it is a question of studying the performance of a wind turbine connected to a constant load of resistance type as a function of the speed of the area in the tunnel. To do this, the learner will perform the following tasks:

STEP 1 - Take control of the computer associated with the EEEC unit and launch the EDIBON SCADA, EEEC.exe. Make sure that the computer is connected to the main interface by clicking on the Start button.

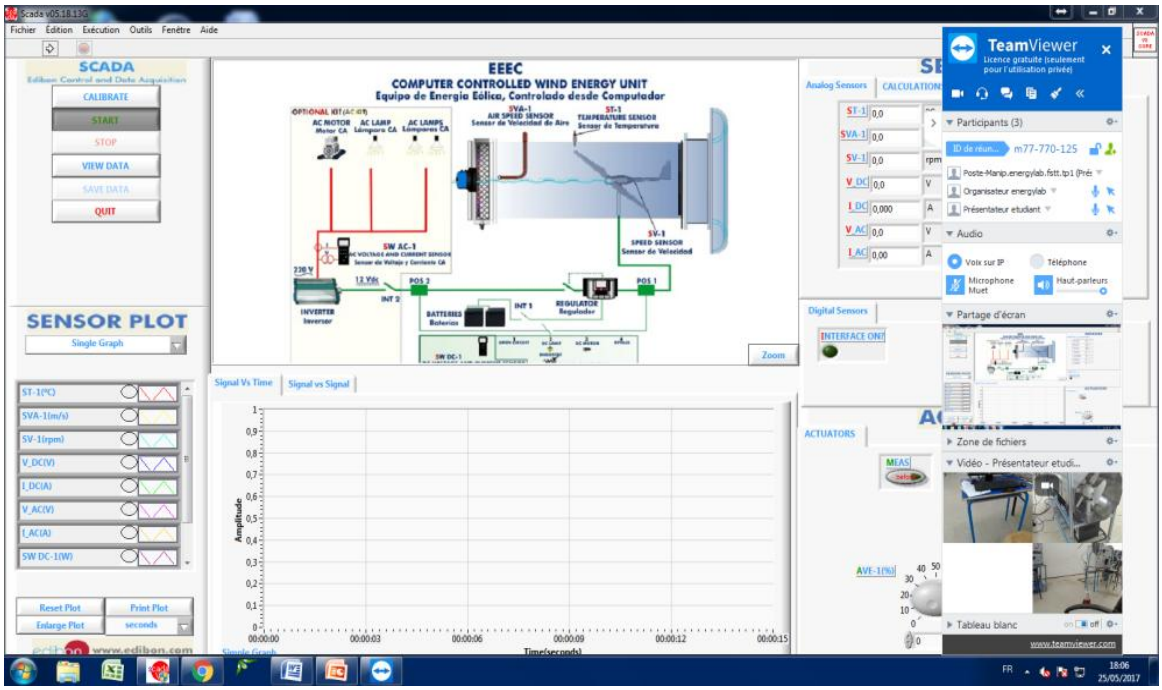

Figure 10 - STEP 1 post-manipulation

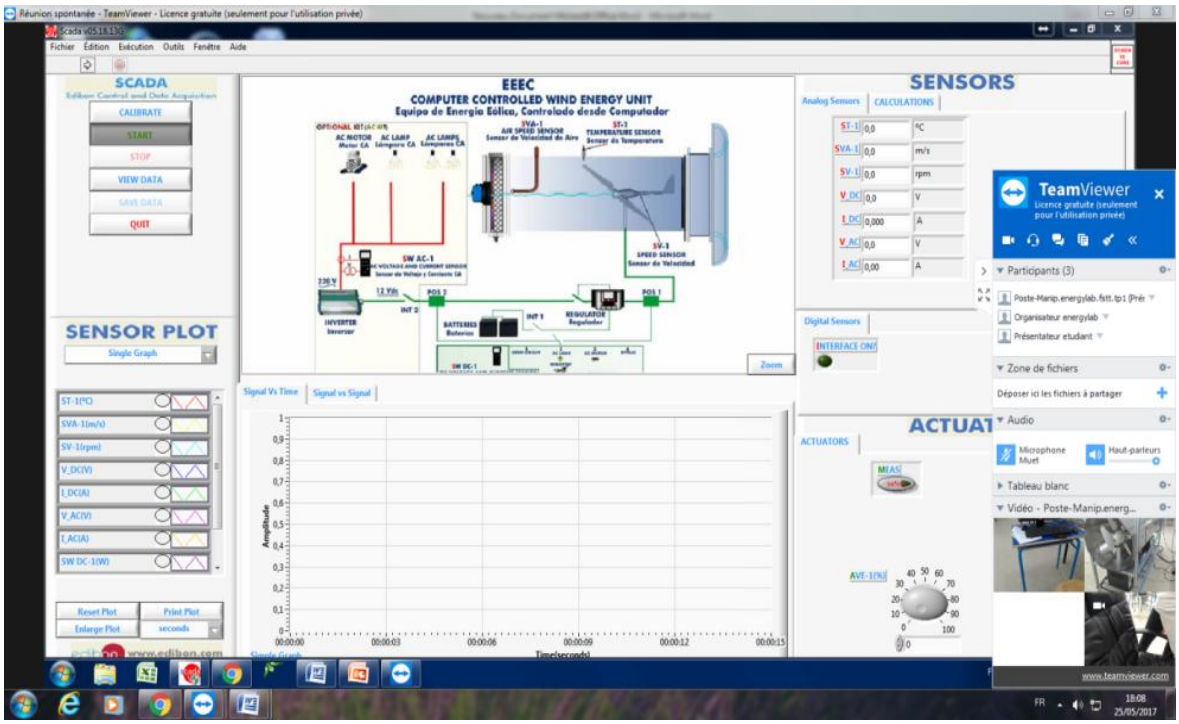

Figure 11 - STEP 1 Administrator agent screen

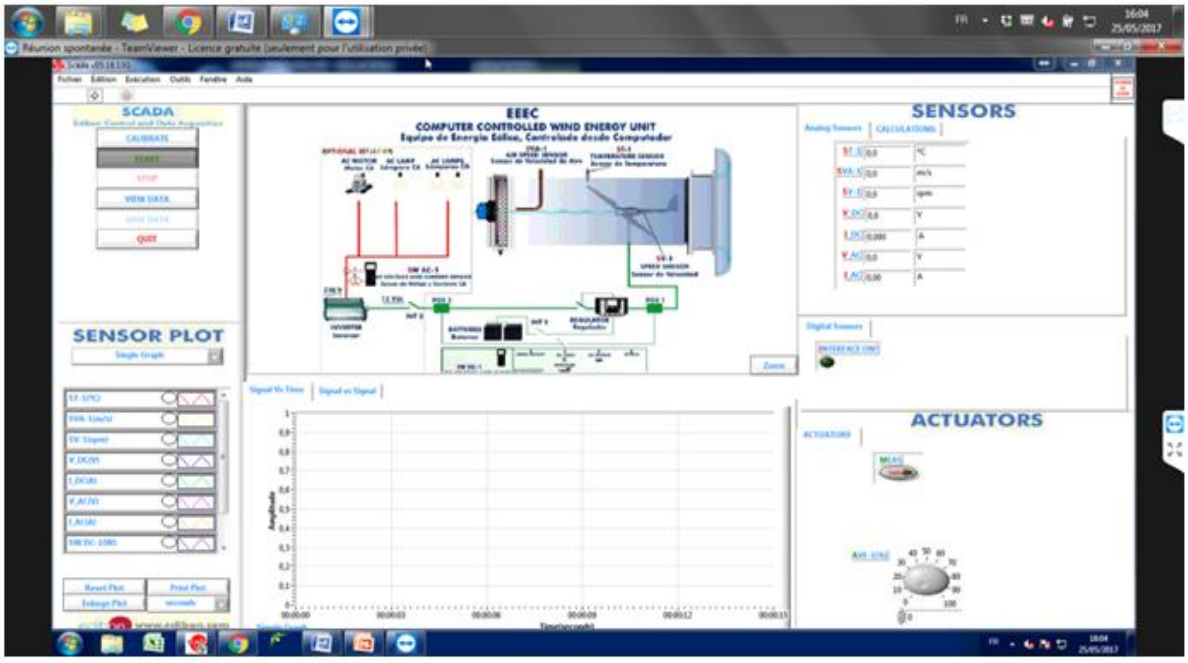

Figure 12 - STEP 1 Presenting agent screen

STEP 2 - Define a recording path for the file containing the sensor measurements returned by the acquisition card.

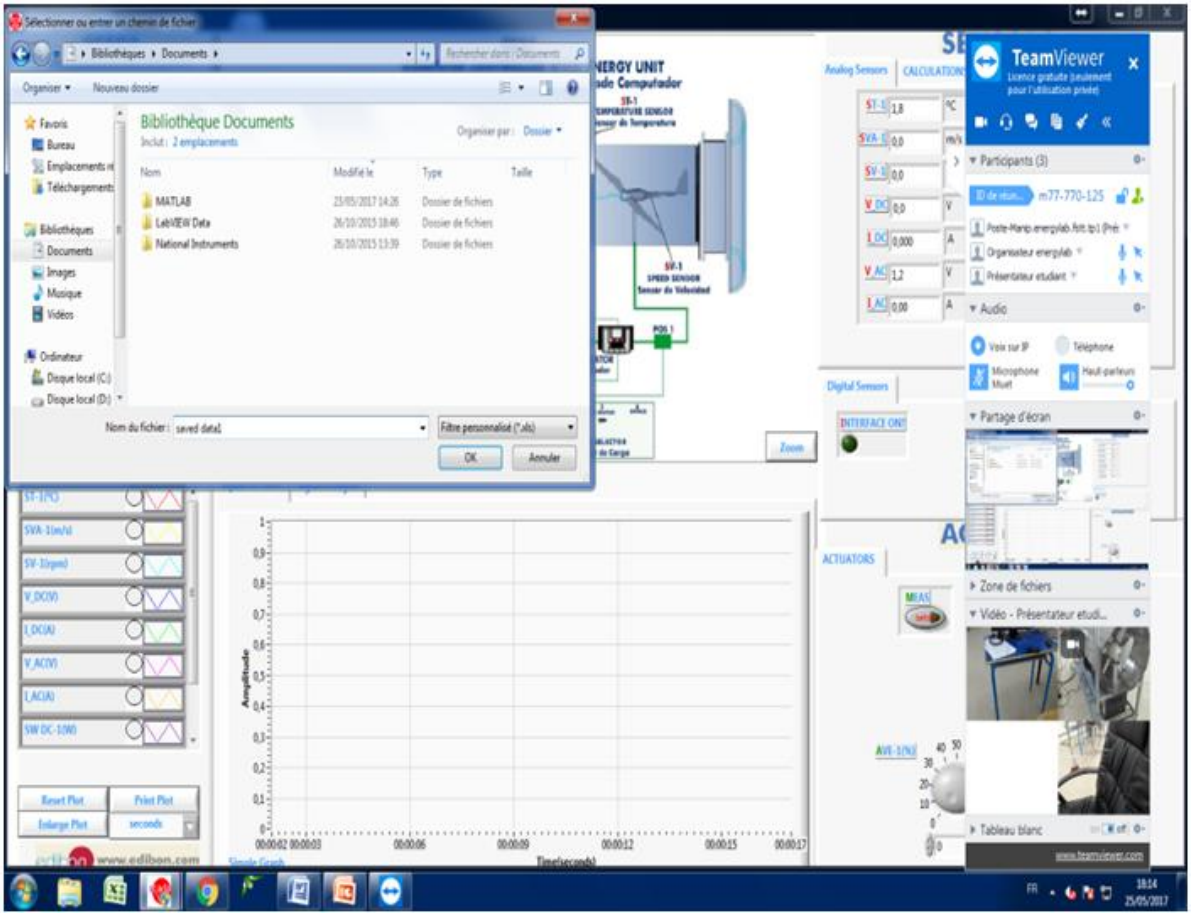

Figure 13 - STEP 2 post-manipulation

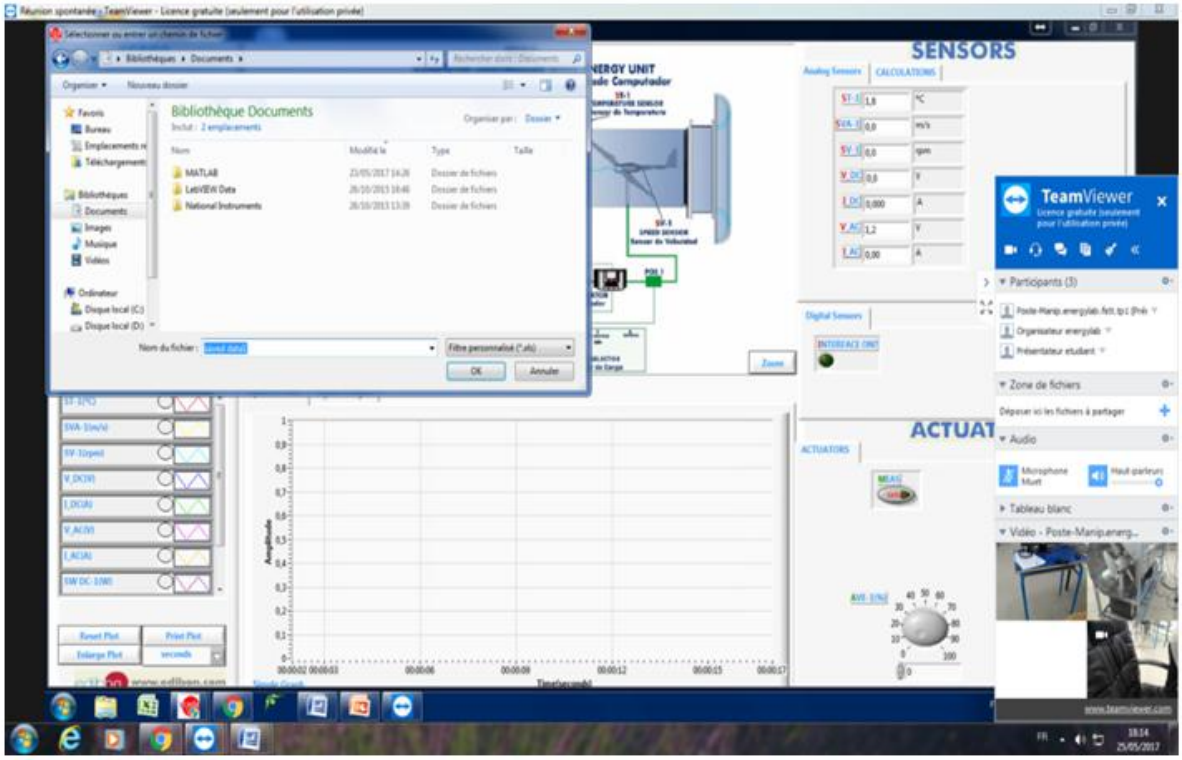

Figure 14 - STEP 2 administrator agent screen

STEP 3 - Increase the fan speed so as to vary the speed of the area in the tunnel from minimum to maximum.

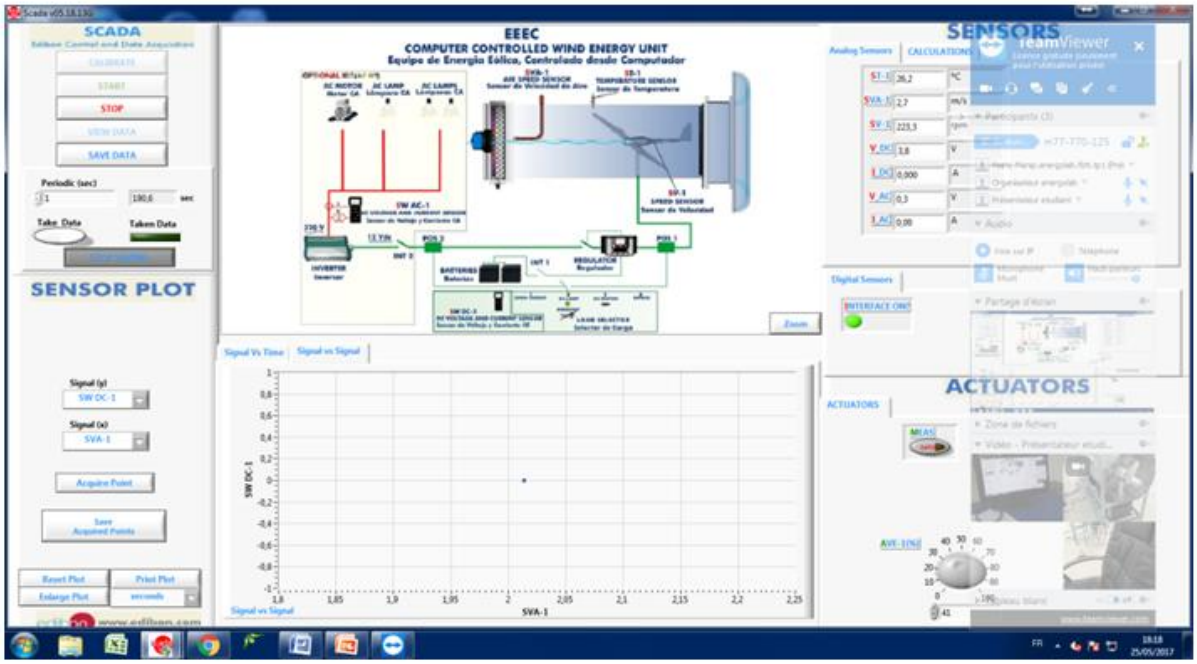

Figure 15 - STEP 3 post-manipulation

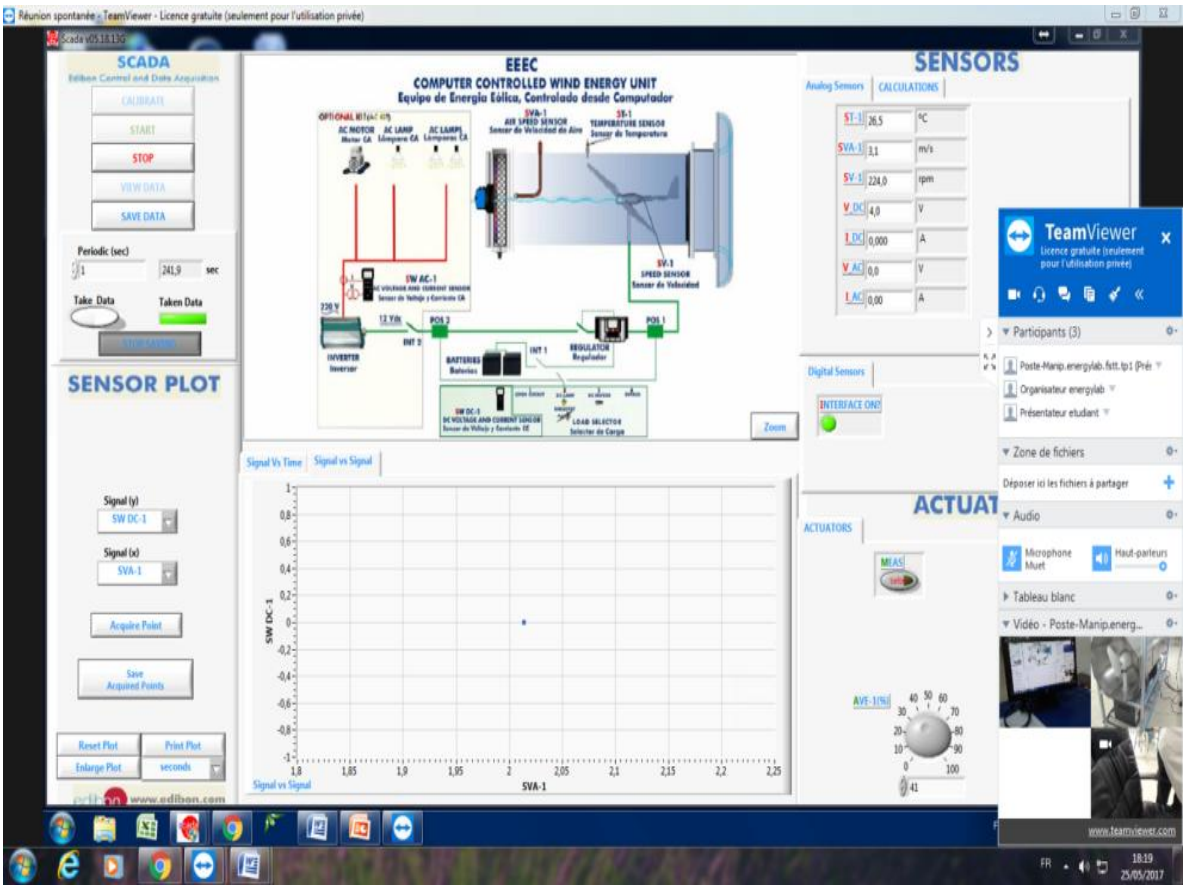

Figure 16 - STEP 3 Administrator agent screen

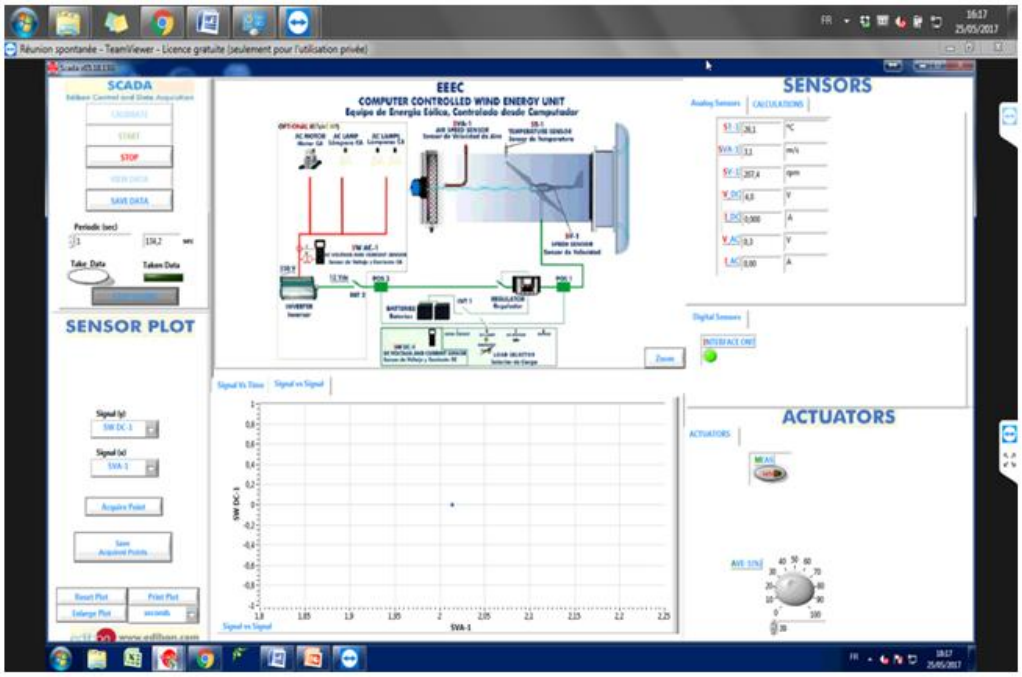

Figure 17 - STEP 3 Presenting agent screen

STEP 4 - Retrieve the measurement file and plot the power ***P*** measured in (w) as a function of the air velocity ***v*** measured in ($m.s^{-1}$).

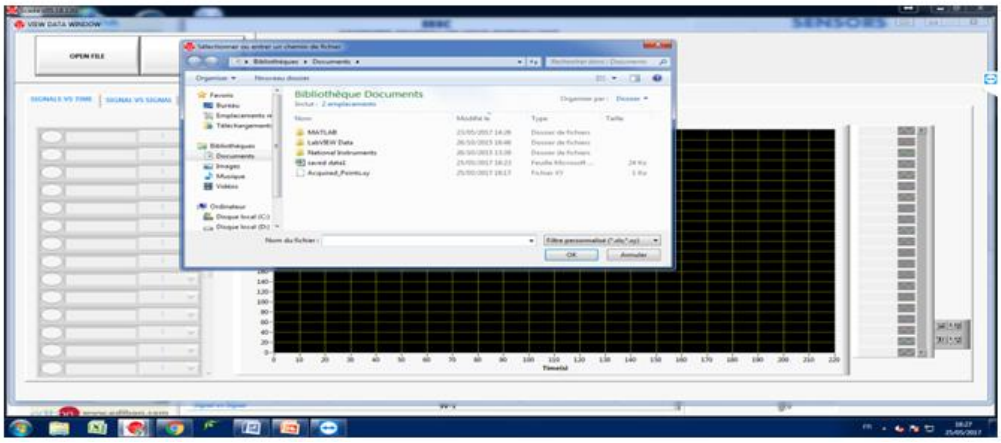

Figure 18 - STEP 4 post-manipulation

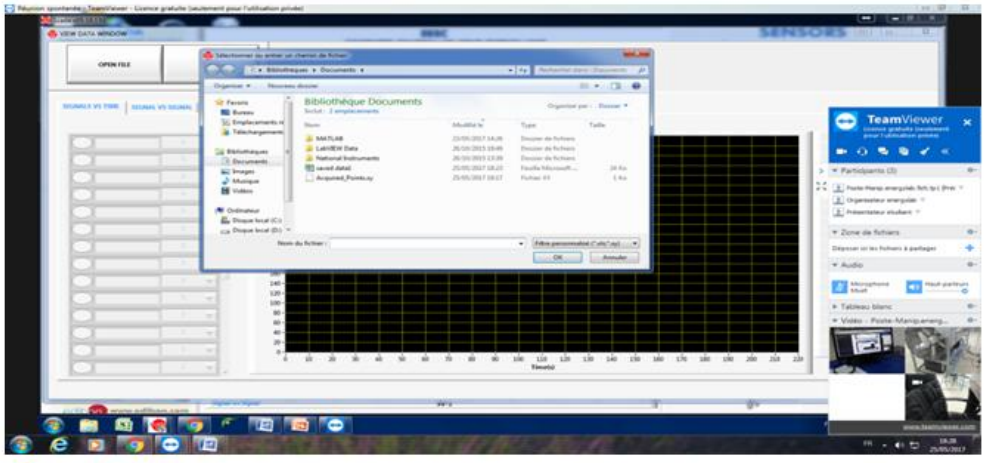

Figure 19 - STEP 4 Administrator agent screen

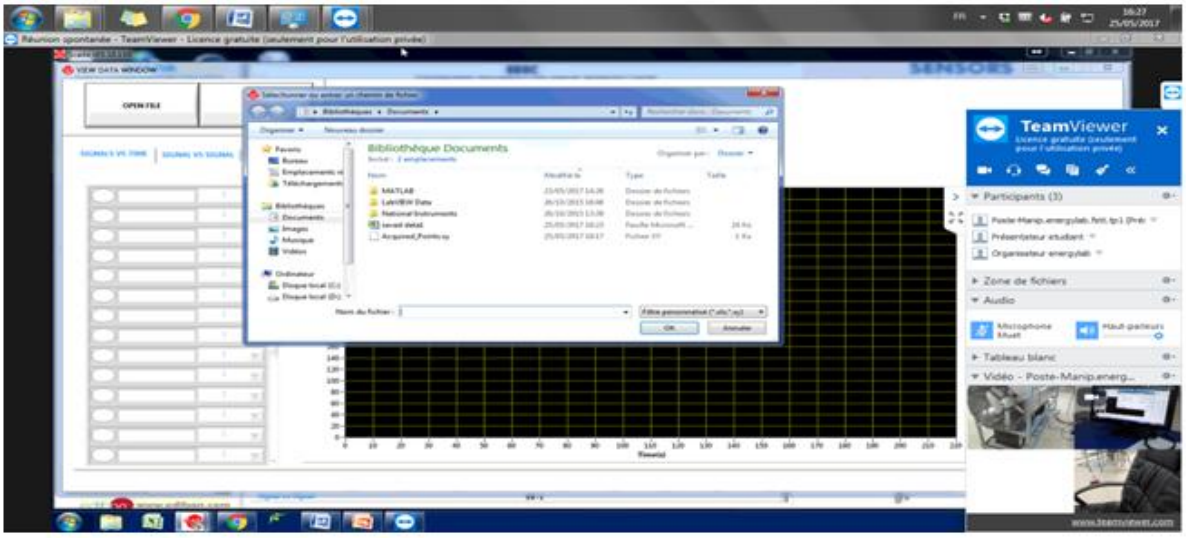

Figure 20 - STEP 4 Presenting agent screen

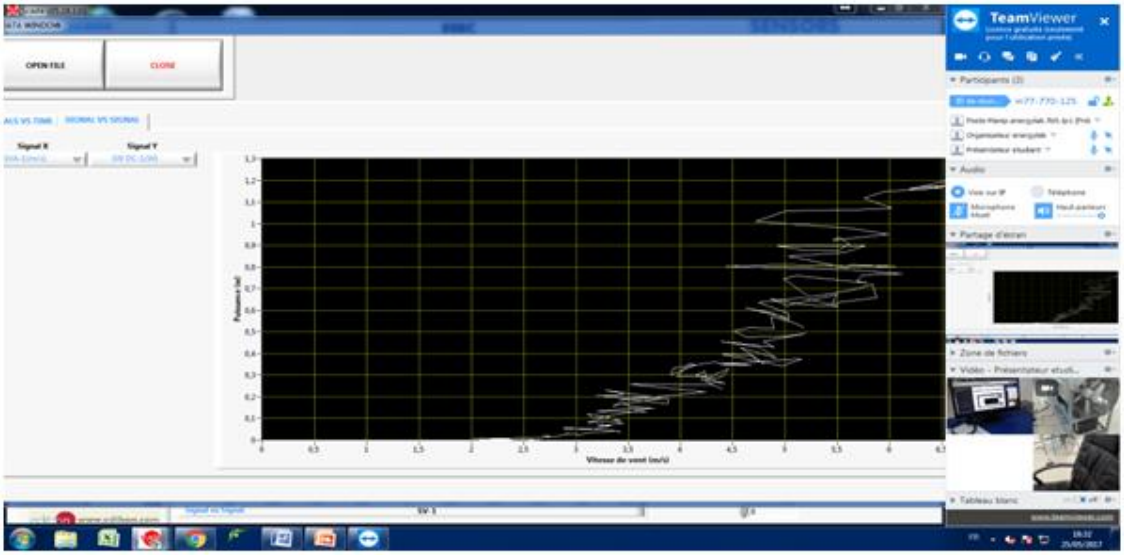

Figure 21 - STEP 4 post-manipulation 2

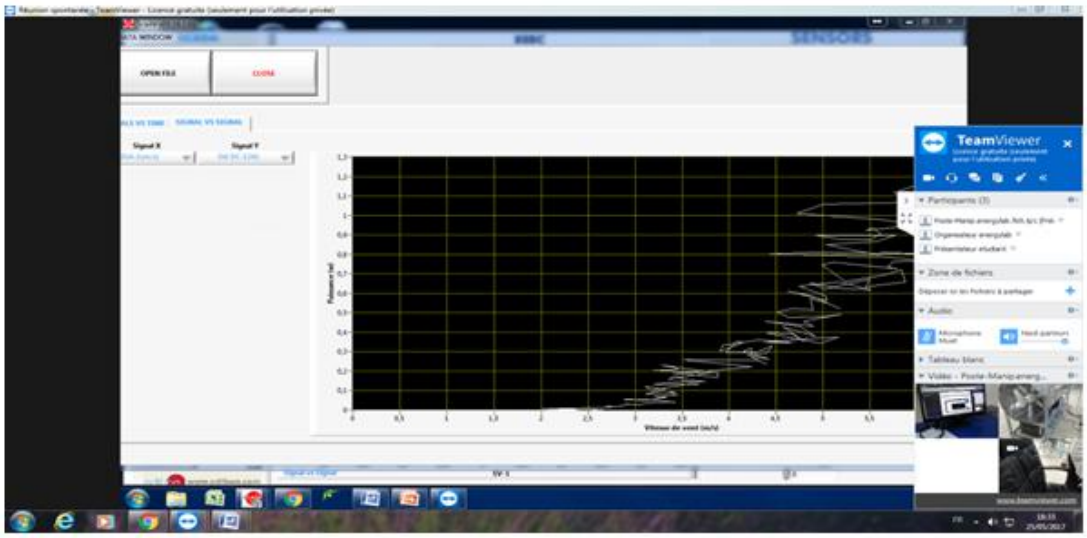

Figure 22 - STEP 4 Administrator agent screen 2

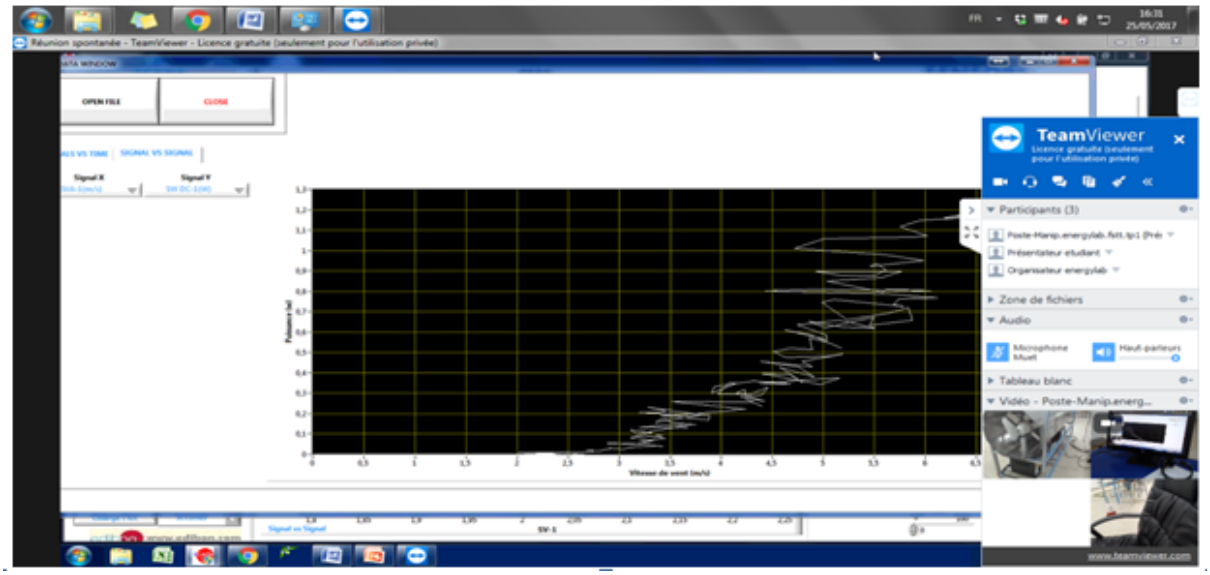

Figure 23 - STEP 4 Presenting agent screen 2

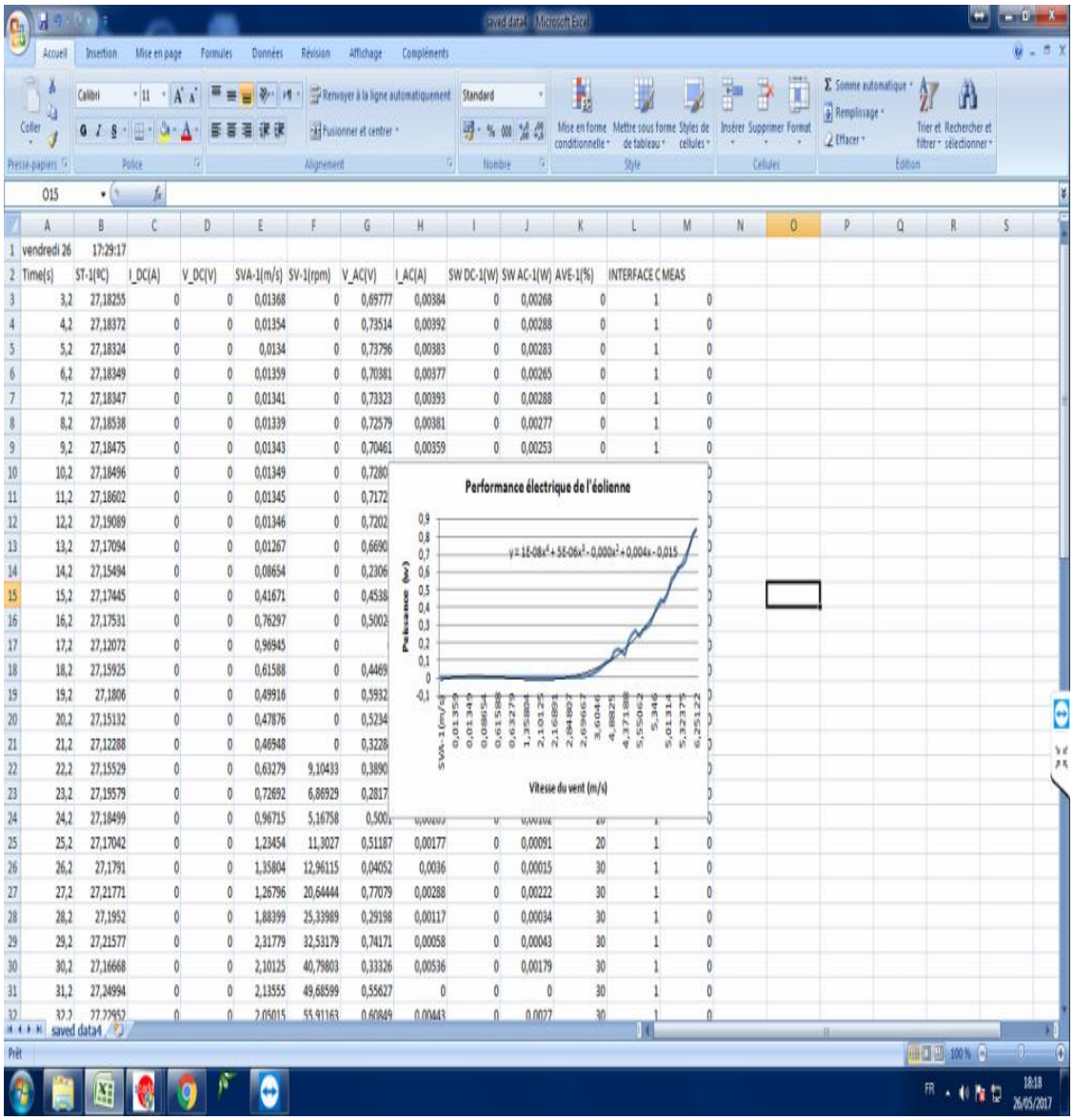

Figure 24 - STEP 4 Results of the electrical performance of the wind turbine

Note: The TP organizer can lead several sessions in parallel according to the specifications

Bibliography

[1]. Billaud Michel, Zimmer Thomas, Geoffroy Didier, Danto Yves, Effinger Hans, Seifert Wilhelm, Martinez Javier, Gomez, Francisco (2002). Real measures, virtual instruments. Proceedings of the Fourth IEEE International Caracas Conference on Devices, Circuits and Systems.

[2]. Leproux Philippe (2011). LABENVI, un espace d'apprentissage pratique en ligne des technologies microondes et optiques. Carrefour des Possibles, Limoges.

[3]. Leproux Philippe (2012). Apprendre en continu, apprendre en temps réel. TIC 2013, les nouveaux temps réels. Fyp éditions, Limoges.

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