2016

"Monitoring and Evaluation of Natural Hazard Preparedness at School Environment"

Newsletter #2
E-preS architecture

Project co-funded under the Union Civil Protection Mechanism, Grant Agreement No. ECHO/SUB/2014/698447

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1. Introduction

The present newsletter aims to provide information on the E-preS system and how to use to perform evacuation drills for schools and other public buildings.

E-PreS "Monitoring and Evaluation of Natural Hazard Preparedness at School Environment" Project can contribute to the reduction of the consequences of disaster events at schools and workplaces, through students and staff enhancement to respond effectively in case of a disaster. E-PreS is thus a novel approach for monitoring evacuation drills taking into account the specific needs of each school or workplace. The aim of E-PreS System is to reveal drill weaknesses, and gaps in order to improve emergency planning. The main goal of E-PreS is the design and evaluation of drills and exercises that are an extremely important part of emergencies mitigation. It will help school staff and students to understand any hazard effect and be prepared to react appropriately. Moreover, it aims to become a valuable tool to experts in the field for monitoring the evacuation process and identify weaknesses in the evacuation plan. Modifications of the evacuation plan will be tested on site and results will be saved for later review and/or compared in almost real time, helping making decisions and finding the best solution in every case.

The E-preS system consists of hardware equipment that has been acquired by all project partners as well as accompanied software developed by the UoA for project needs.

2. The E-PreS architecture

The E-preS architecture system consists of a set of hardware and software components that have been developed by the UoA. The hardware represents the **sensor infrastructure** to monitor and assess the drills and **the back end server**, a computer system to manage drills and store data.

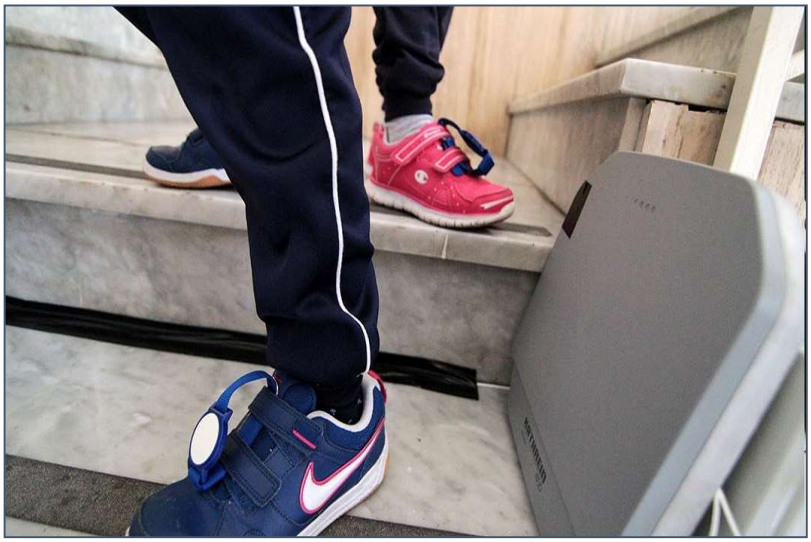
The **sensor infrastructure** consists of proximity sensors distinguished in two kinds. The first kind is the **lightweight wearable** sensors (tags, like those existing at commercial goods at Moles and big markets) that are carried by the participants of the drill, and allow for their localization. The second part consists of the **antennas that sense RFID tags**, the **readers** that collect the antenna's readings, and the **processing** unit that forwards those readings in the back end system for further manipulation. The latter part is referred to as a node or a checkpoint in the E-PreS system, and allows for monitoring a certain area inside a building, for example a classroom's exit. A **node**,

consisting of two antennas, a reader and a processing unit is enclosed in a case for mobility and flexibility reasons.

The main parts of the sensor unit are the following:

- RFID tags

Lightweight wearable sensors to be carried by the users and to allow for constant, almost not perceivable, interaction between the user and the system. The sensors are comfortable to wear without any user disruption, normally on shoes.



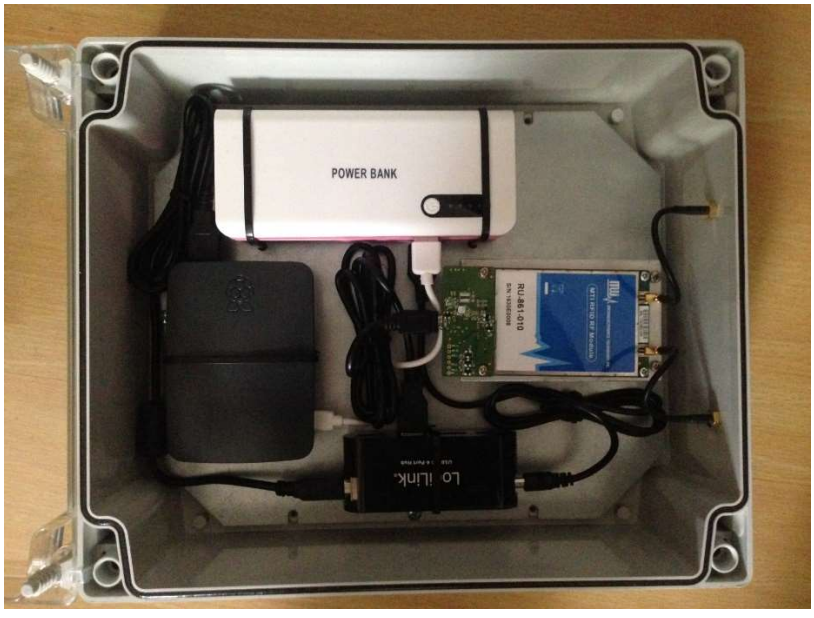
- Reader

The reader provides read and write capability for all compliant tags. The module provides monostatic performance with two independent external antenna ports. The **reader** is composed of three parts. The **Microcontroller** contains the RFID system firmware. The **Transmitter** supports

from +5~+30dBm output power with low power consumption. The **Receiver** composed by two antennas utilizes monostatic technology.

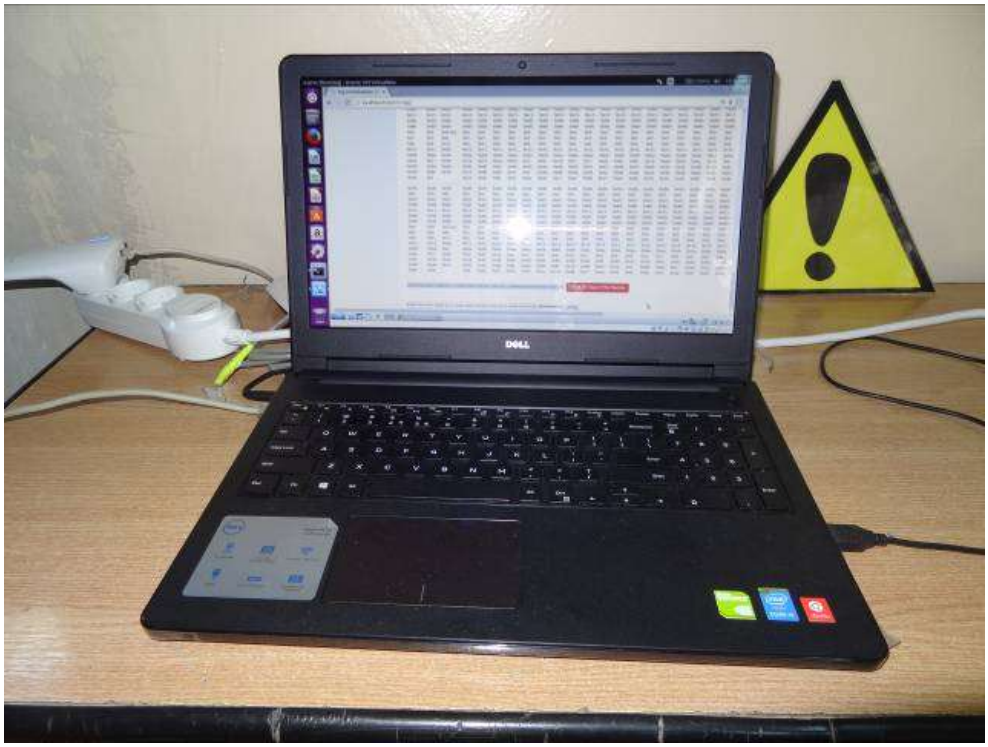
- Processing and Transmitting Unit

Processing and transmitting unit sends RFID tag readings from the reader to the server. It is a small single-board computer build on a single circuit board, with microprocessor, memory, input/output and other features like on board Wi-Fi 80211n . The operating system is a Debian based Linux distribution. In the process unit, the routine receives tag readings from the reader and passes them to the server system, where it is eventually stored in a hard drive. A power bank provides power supply to the processing unit, and as a result the whole sensor unit is mobile. The process unit communicates with the back-end system through Wi-Fi. Thus a mesh network is created and messages from nodes can reach the back-end server.



- Back-end server

The back-end server is a laptop based managing and storing infrastructure which is based on a linux environment. A Virtual machine is used for the operation and management of the drills, as well as to create in some cases the E-PreS Wi-Fi communicating system to connect and communicate with the nodes. In some cases an external router is used to produce the E-PreS Wi-Fi network, where both computer and nodes are connected too.

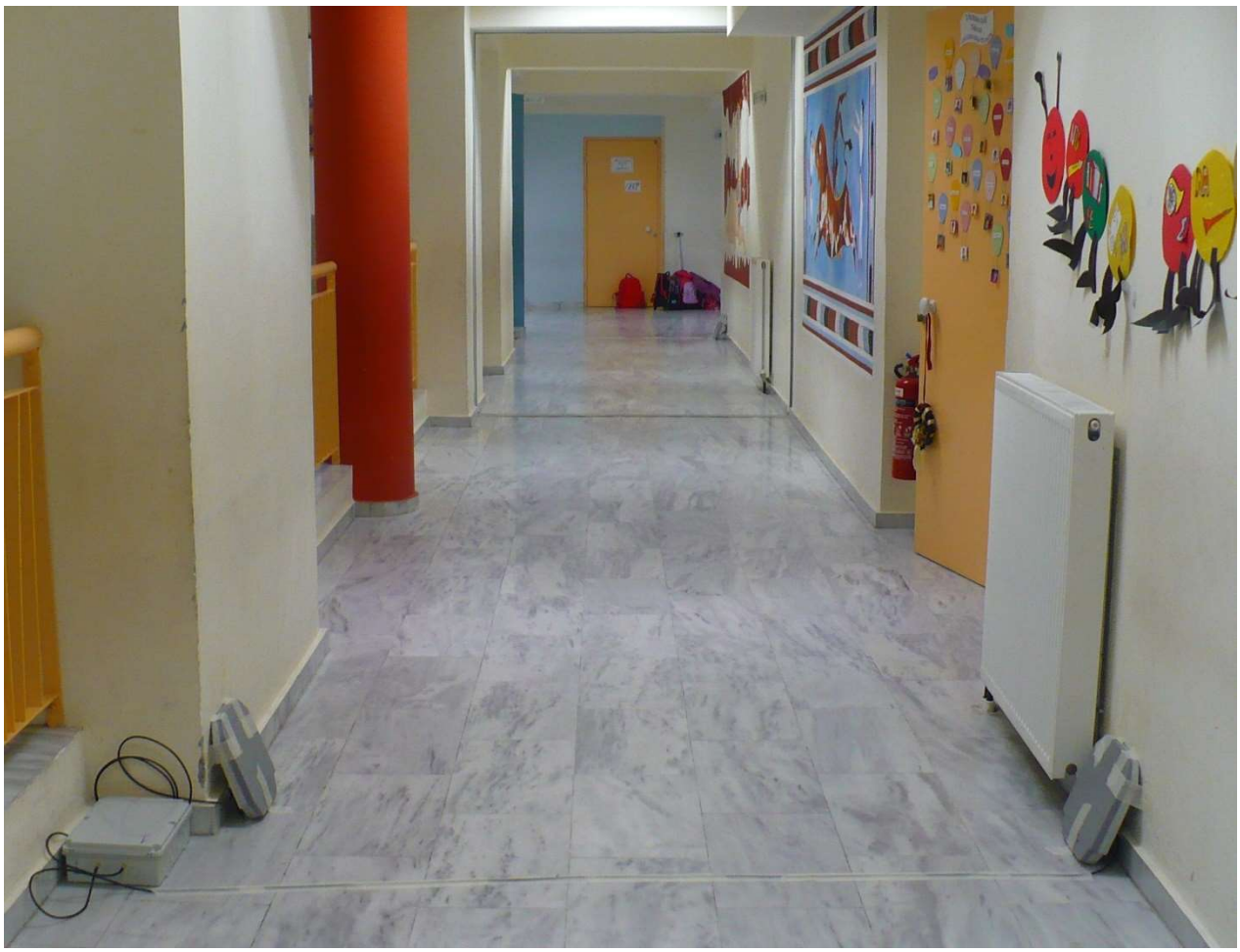


3. How to develop an evacuation drill

To design and implement an E-preS evacuation drill is a three step process: A preparation phase has to be implemented in situ (at the building where drill will be executed), the tag (Rfids) initialization, and then the implementation of the drill at a building has to take place.

3.1. Preparation phase

Prior to a drill it is necessary to study in detail evacuation plan of the building in order to put the necessary check nodes on the most appropriate positions that will not affect evacuation process and will serve to check weakness and gaps.



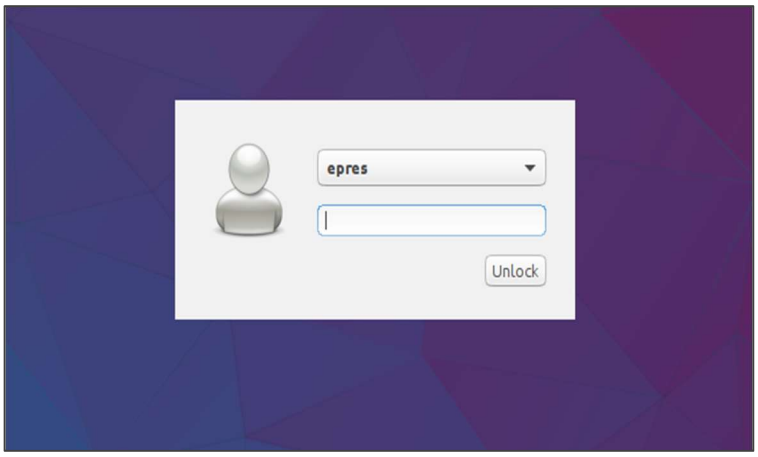
Prior to each experiment the following process has to be accomplished:

If the system uses an external router to create E-PreS Wi-Fi network, power on device and put in an appropriate position. Then install Wi-Fi extenders if necessary (you can check with a mobile device the strength of the signal)

1. Log in:

Username: epres

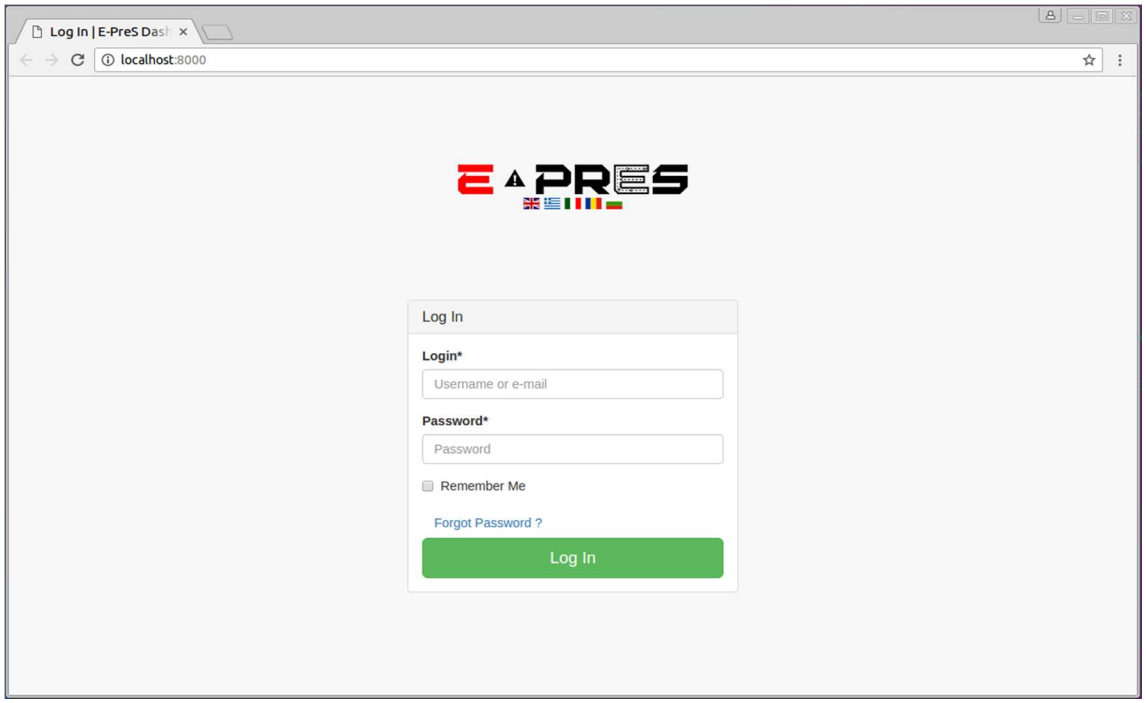
Password: epres!2#



2. Open a browser window (preferably Chrome) and wait. The whole system will load.

3. Log in with the username and password provided to you by UoA.

3.1. If you create E-PreS Wi-Fi network by laptop, you should create the network by clicking on the Network connection icon and press “create” to create E-preS Wi-Fi network. If you are using external router you should connect to E-preS Wi-Fi by clicking connect from the same Network icon.

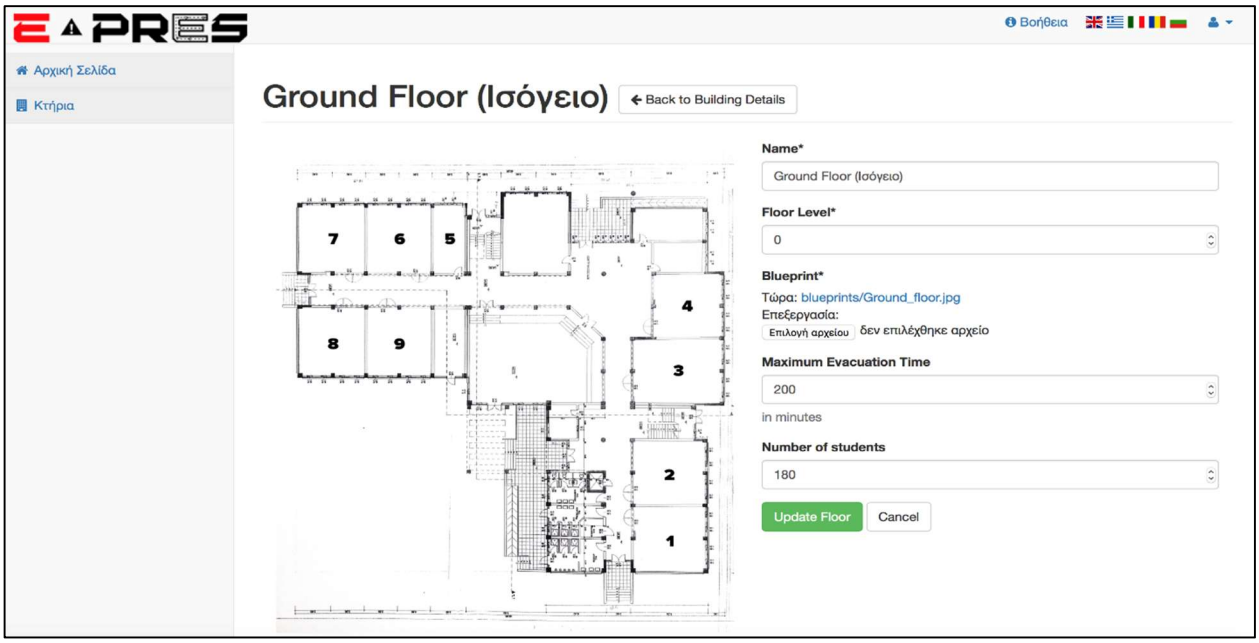


4. Power up each node, the antenna reader and the raspberry.

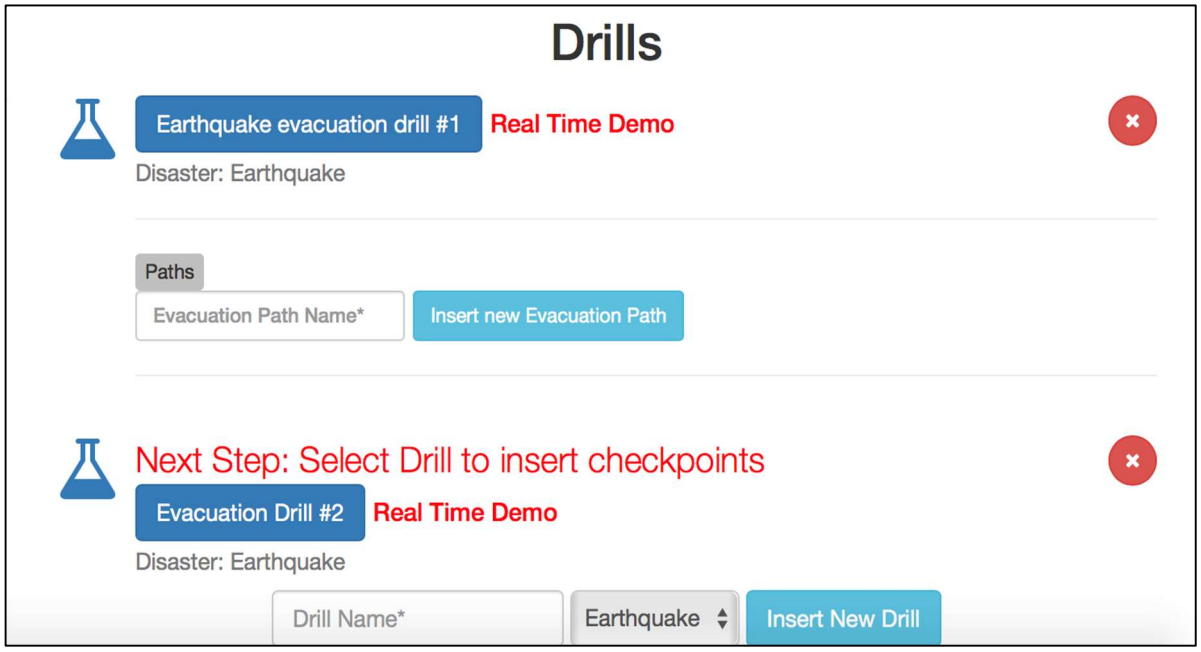
5. Visit http://localhost:8000/antenna-status and make sure that all nodes are active and connected.

6. Pass the testing tag from each node. In the http://www.localhost.gr/init-tags you will be able to see the tag passing from node to node. Upon passing from the nodes, they are ready.

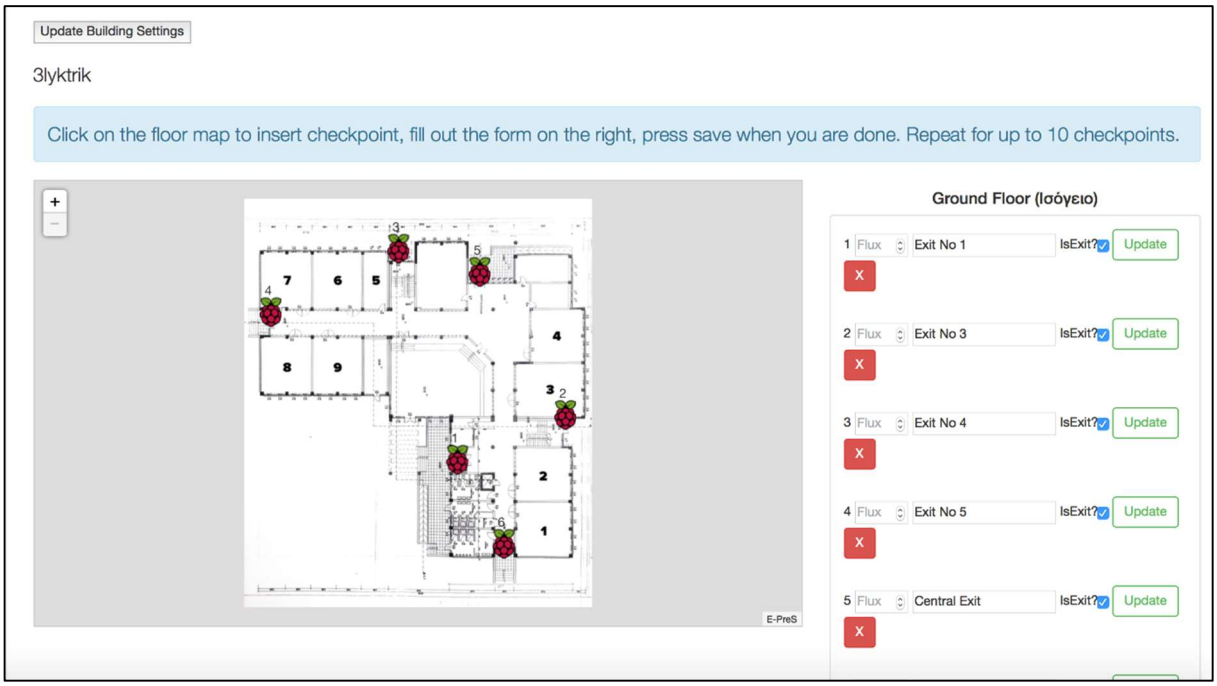
6.1 Design a drill and Register nodes in the system. After having installed the nodes in the building you have to design the drill and insert check points. You have to go to http://localhost:8000/building and add the floors of the building that will be used for the drill. You can upload an image of the floor plan in jpg, png or else format.



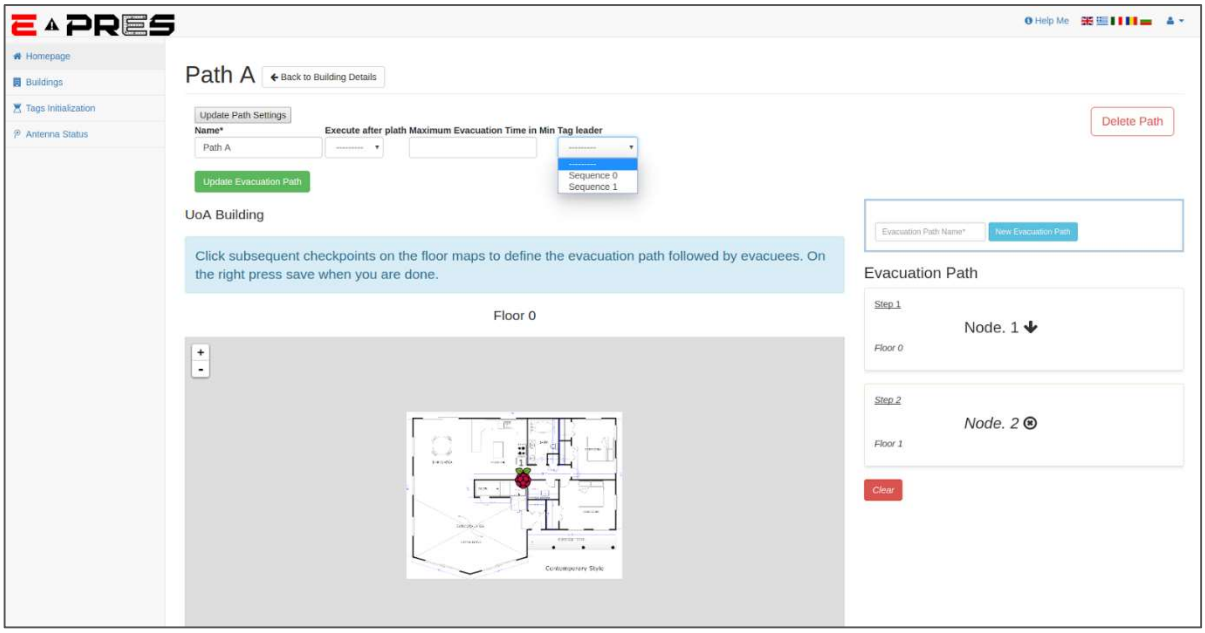
Then you will be asked to “Insert new Drill”. From the bottom of the page you go to “Insert new drill”, by adding the necessary info (name, reason for evacuation). You will be asked then to “Select drill to insert checkpoints”. By clicking the drill you are transferred again to the floor view.



You just click on the image of a floor and add the checkpoint on its position. Each checkpoint corresponds to an installed node. For each node you can give a name, add the expected flux of pupils, and if it is an exit, click the nearby box. You should then press Save in order to register and continue with another checkpoint. Be careful though that the number of the Checkpoint should correspond to the numbering of the nodes you have used (i.e. the first checkpoint to register should represent the node with No 1, the second to register the no 2 etc.)



6.2 Design evacuation paths. In order to design the evacuation paths of the drill you have to click "back to Building details" (or go to http://localhost:8000/building) and under the drill name you can find the option to "insert new evacuation path". Note that for each classroom you need to create one evacuation path. You give a name (normally the name of the classroom it refers to) and you insert the path. You are transferred again to the floor plans where for each path you have to click the order of the checkpoints that the path will follow by clicking one by one the checkpoints. After finishing you press "save". On top of page you can modify path settings by clicking "Update path settings". There you can add more info on the path like the order of path execution (prior or after another path if desired), evacuation time, and most important and necessary for drill implementation, to correspond a tag leader (a teacher) with the specific path. If you skip this last setting you will not be able to execute the drill. Settings can change also after inserting all paths.



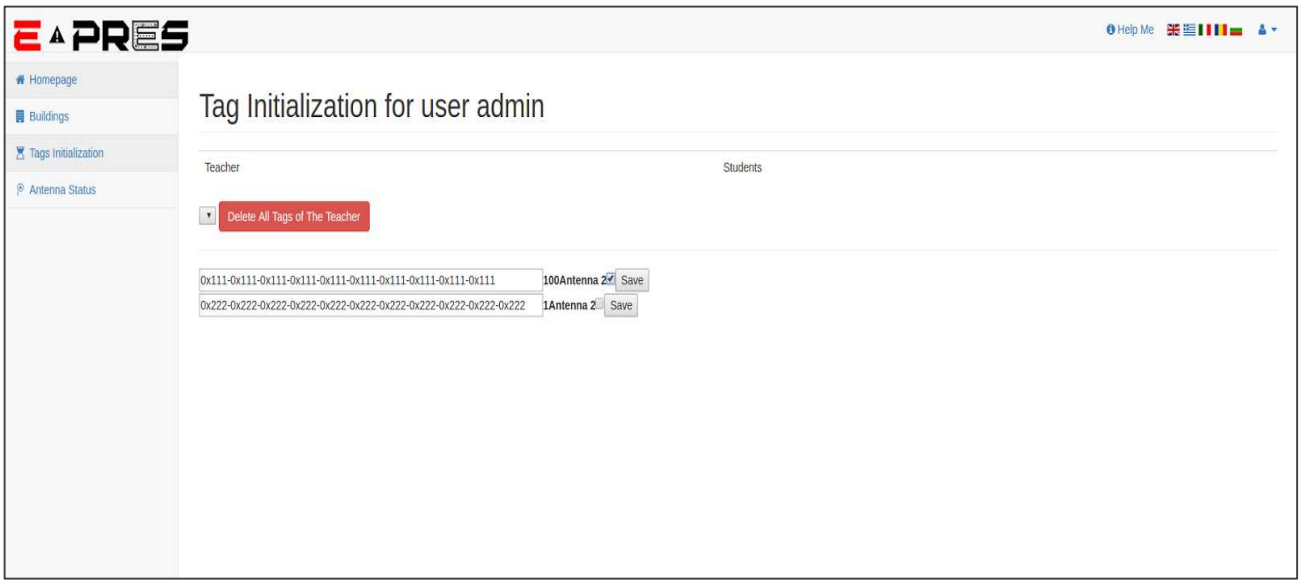
After updating settings of a path you can insert “new evacuation plan” and so one, till you have inserted one path for each participating classroom.

3.2. Tag initialization

Tag initialization is a process that has to be implemented for each building and for each drill execution. After having inserted the check points on a building you need to initialize the tags that will be used during the drill.

The following procedure is advised to be done only once. Do not repeat it before each drill. To initialize the tags and associate a teacher’s tag with the students’ tags, you should:

1. Mark a tag to be used as a testing tag (e.g. using a marker). This tag will not be used for any other purpose. This is the only tag that will be used before each evacuation drill to make sure that the nodes are setup and functioning correctly.
2. Group the tags per classroom (e.g. make groups of 26 tags. 1 tag for the teacher and 25 for the students). Mark the teacher’s tag clearly so that you can find it easily among the students’ tags.
3. Assemble one node, power it on, start the laptop and wait until the server starts.
4. Using a browser, navigate to http://localhost:8000/antenna-status and make sure that the active node is visible, thus ensuring that it functions correctly and communicates with the server. Navigate to http://localhost:8000/init-tags



5. Place the tags far away from the antennas of the node to avoid accidental detection. 5.1 You can skip steps 3, 4, and 5 if you are in the building and have already installed in situ the check points (See: Prior to an experiment instructions)

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6. For each group, place the teacher node in-between the antennas. The tag will be detected (multiple times). Check the corresponding box to show that this is the teacher’s tag and press “**save**”. Don’t reload the page.

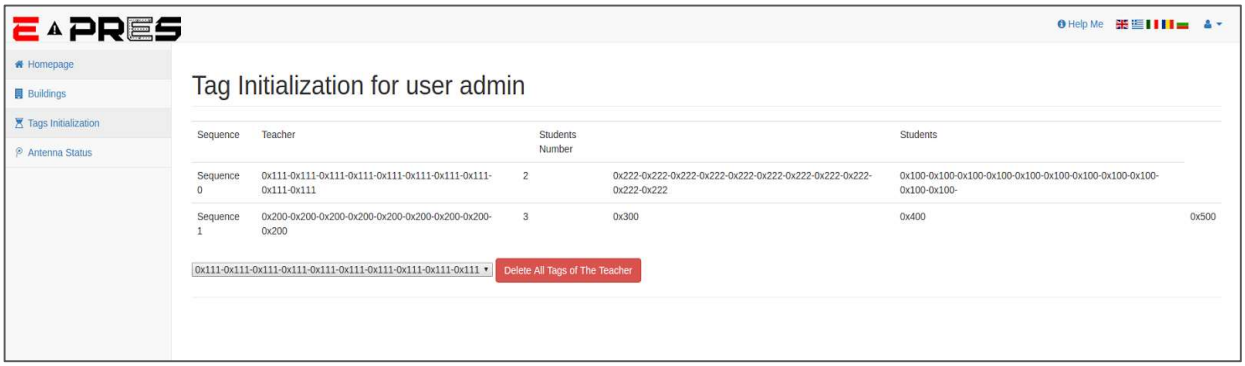
7. Place each of the student's tags of the same group in-between the antennas and just press "**save**".

8. Check the tag leader (teacher) and make sure that it is showing first along with the corresponding student's tags.

9. Move the tags at a safe distance.

10. Refresh the page. The tags that are registered will not show up again. A "Sequence" of cards is thus created starting with "Sequence 0", followed by "Sequence 1" and so on.

11. Repeat the above process for every group.

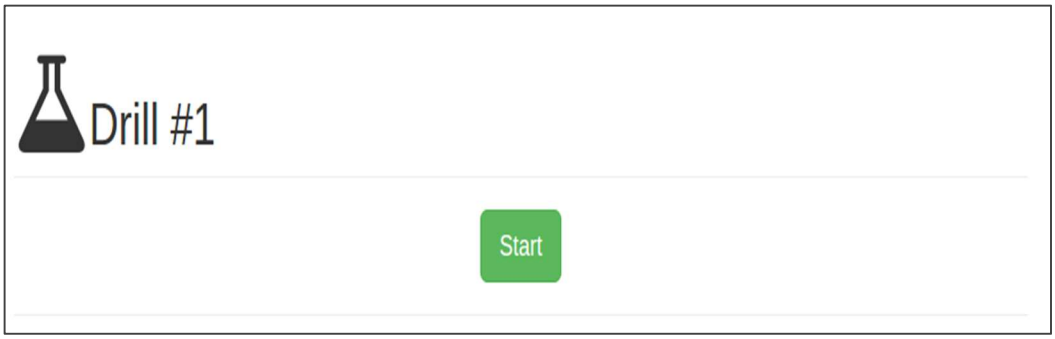


During the preparation phase of every drill assign each sequence of tags to a specific evacuation path (and thus with each classroom – since the evacuation path is unique for every classroom). In the following pictures we chose Sequence 0 for the specific evacuation path.

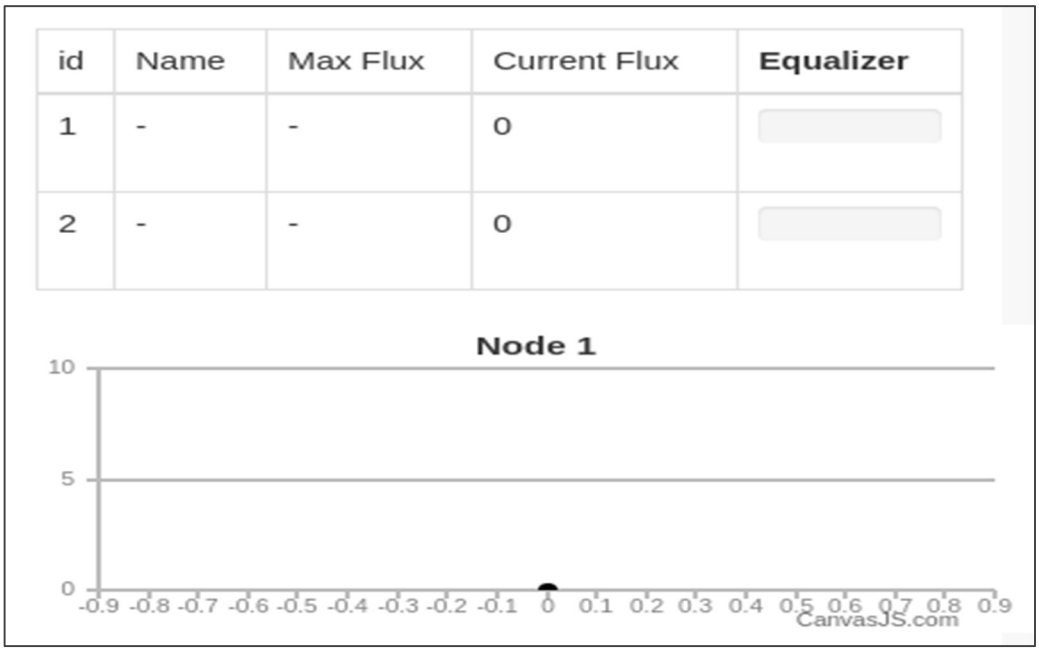
3.3. Drill implementation

To implement the designed drill you have to http://localhost:8000/building, choose a building and the specific drill and press "Real time" next to the corresponding drill.

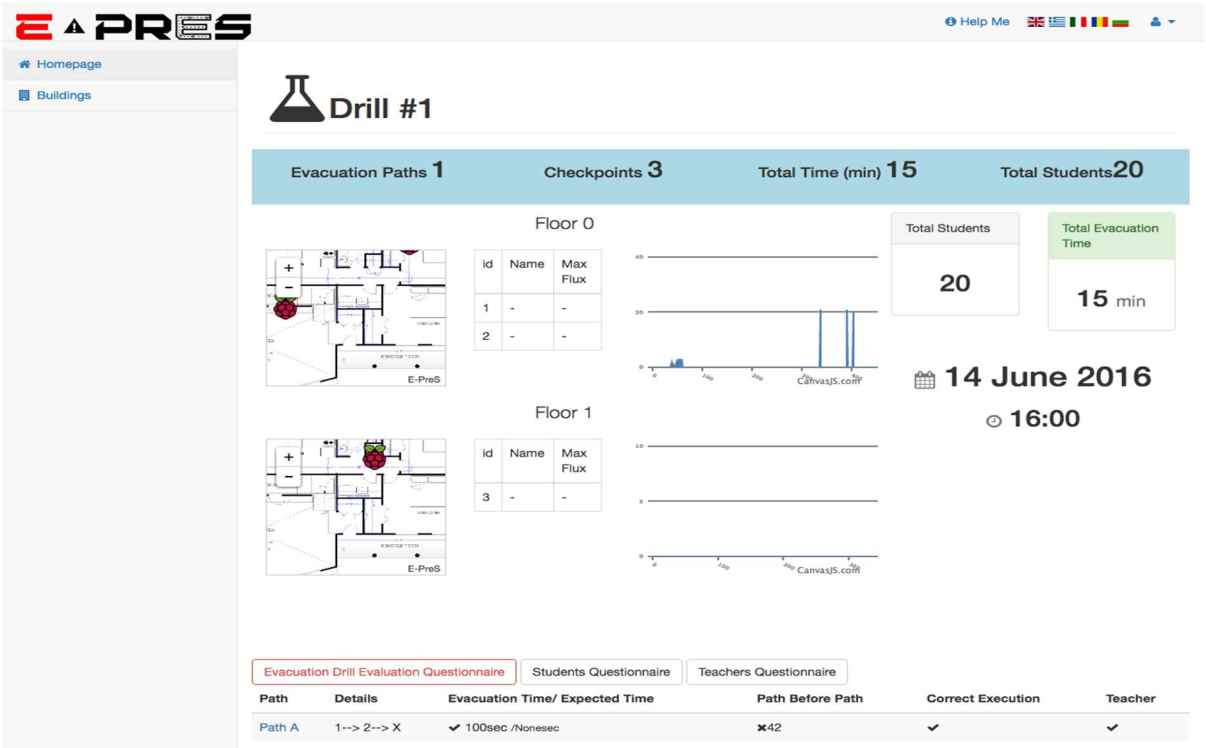
1. If everything is ok, the "Start" button will appear along with the name of the drill.



2. Press "Start" (The "Start" becomes "Stop") and check the first node.
3. As soon as the first dot appears on the graph, it is an indication that the drill has started and the school bell can signal the start of the drill.



4. At the end of the trial press “Stop” and navigate to the result page of the experiment to get the results and a list of all the recorded events. If you accidentally pressed the “Start” and need to reinitiate the experiment, press the “Delete all analytics”. The measurements will be deleted and the drill can be initiated again.



5. After the end of the trial, press the “after_drill.sh” icon on the desktop and select “execute in terminal”.
6. E-mail the “email_this_file.tar” file to UoA to update the master database.

7. Use the bottom left icon of Virtual box screen to logout, and choose shut down to exit Virtual box. Then shut down Ubundu.

4. Tips

Here you may find some tips that will help you during drill execution:

- The cables of the checkpoints at the exits and stairways might be a problem for the evacuees. They must be well secured on the floor to avoid falling accidents.
- The checkpoints at the exits and the staircases should be placed in such a way to avoid narrowing the evacuation path and to prevent damage by accidental kicking during evacuation.
- It is better to insert the RFID tags into corresponding card holder in order to protect them.
- The tag holders should be secured in the clothes to prevent tags from falling during evacuation.
- The participants of the drill should wear the RFID tags near to their shoes.
- The antennas are very sensitive, so attention must pay in their placement, in order to avoid records “noise”.
- Sometimes the estimated duration of the evacuation in the platform is larger than the actually recorded. This happened due to the fast moving rhythm of the evacuees. The participants should have a normal pace during the evacuation, not a running pace.