

# VES Demo – Tutorial

## Introduction

The Virtually Enhanced Senses system is a novel and highly configurable wireless sensor-actuator network conceived as a **development and test-bench platform of navigation systems adapted for blind and visually impaired people**. It allows to immerse its users into ‘walkable’ purely virtual or mixed environments with simulated sensors and validate navigation system designs prior to prototype development. In the latest version, it also includes a network emulator to observe the impact of specific network QoS (latency, jitter, packet loss...) on navigation performance.

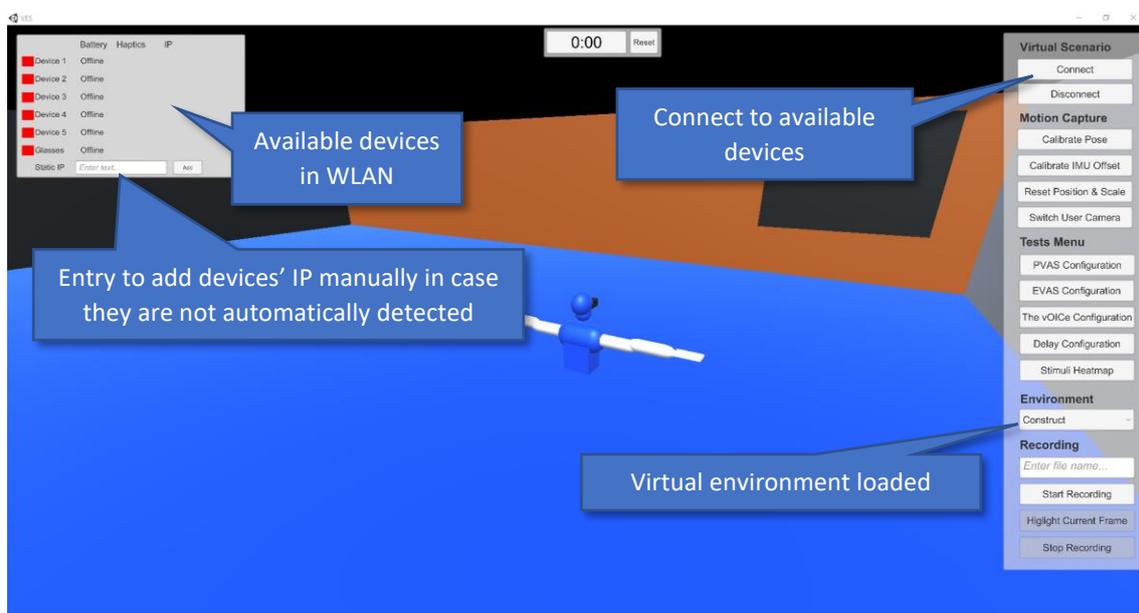
The demo software available online is divided into the following executable files:

- **VES ([android](#) – [windows](#))**: the system’s core with a user-friendly GUI.
- **VES – MoCap example ([download](#))**: it turns an Android device into a wireless 3-DoF motion capture sensor.
- **VES – Glasses ([download](#))**: analogously, this application turns an [ARCore-compatible device](#) into a wireless 6-DoF motion capture system.

## How to start the system

First, execute the system’s core software. In the upper-left corner it will show any available device in the LAN which runs “VES-MoCap example”, “VES-Glasses” or the firmware developed for the ESP32 SoC. Next to the device name there is a state indicator; once it turns green, the device is synchronized and prepared to be connected. Nevertheless, no remote device is required to test some of the key features of VES.

Note: if a MoCap/Glasses device is not automatically detected, its IP should be entered manually in the same menu.



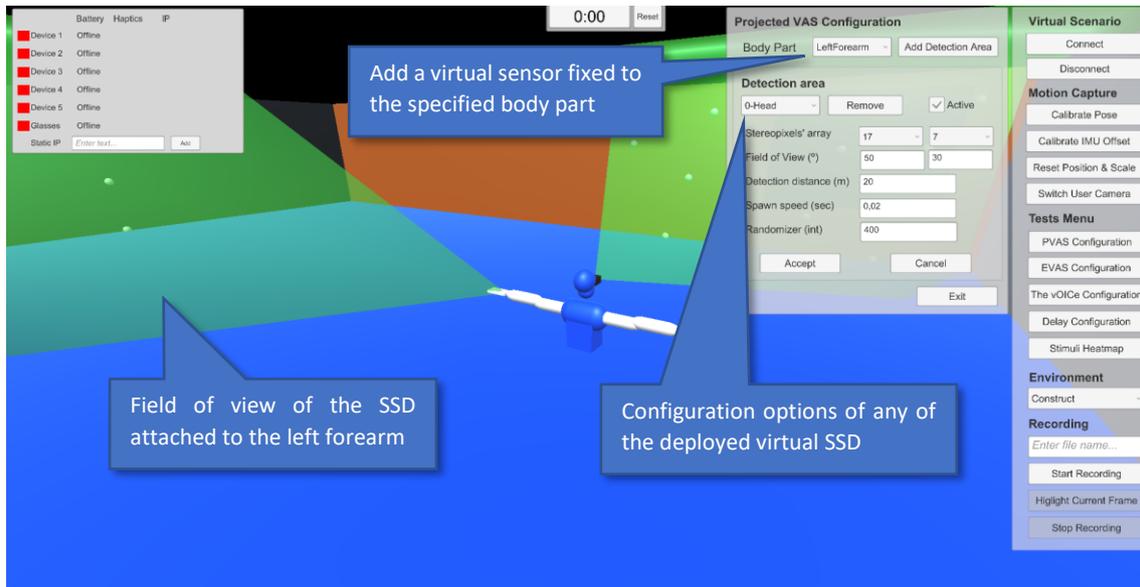
Once a device is connected it will start to provide motion data. To calibrate the user’s movement with that of the virtual body, the “Calibrate pose” should be pulsed while the user copies the

initial pose showed in the screen. Also, the “reset position & scale” button restarts the user position at the center of the virtual environment.

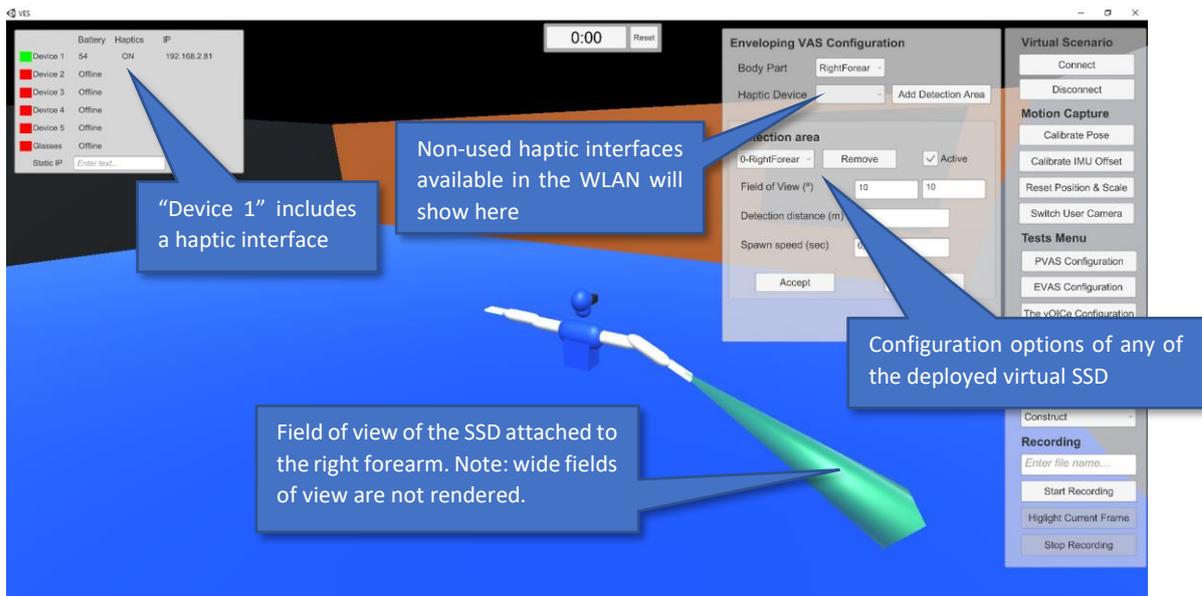
### Sensory Substitution Devices

A total of three SSD have been included in the system under the “Tests” Menu [1]:

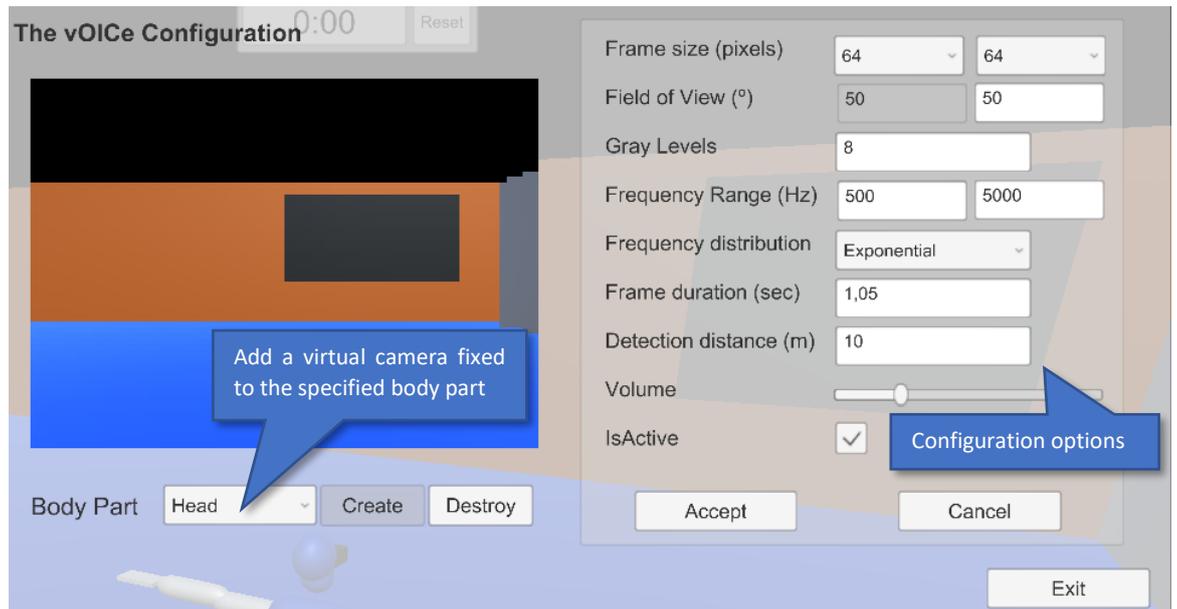
- **Projected Virtual Acoustic Space:** it is a variation of the Virtual Acoustic Space. The surfaces in range of a virtual sensor fixed to the user body are converted to acoustic stimuli.



- **Enveloping Virtual Acoustic Space:** again, a virtual sensor is fixed to the user’s body. The distance to the closest surface in range is encoded as acoustic stimuli. It can be used to generate a one-dimension SSD only by reducing the field of view.

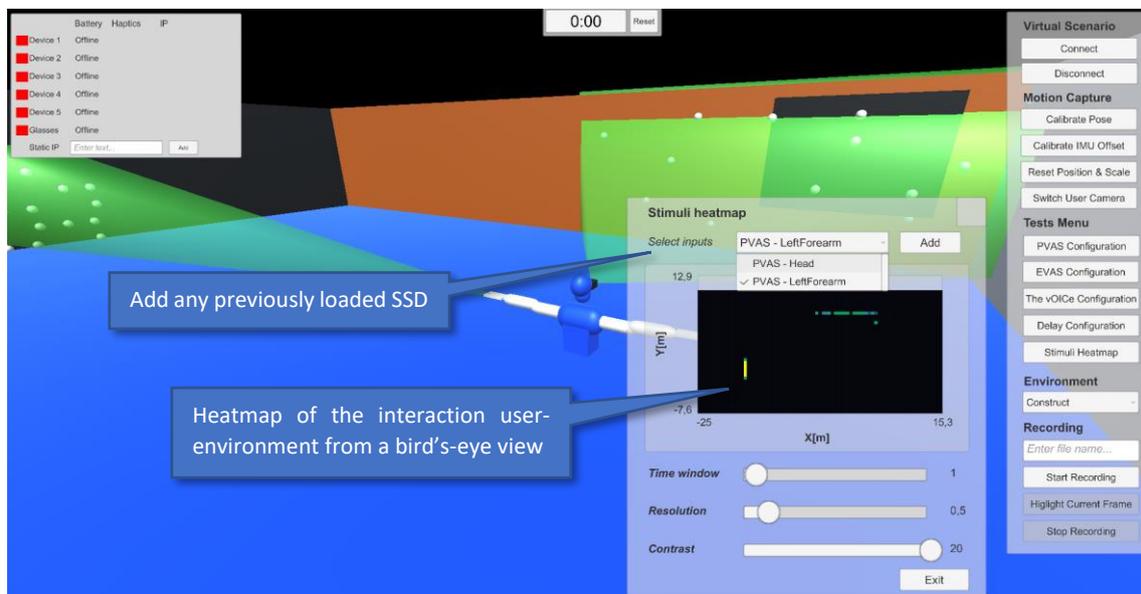


- **The vOICe**: it is a highly configurable implementation of Peter Meijer et. al. sensory substitution system [2].



### Embedded tools

- **Delay configuration**: it is the only QoS variable included in the GUI. It allows to add a Poisson-based delay to the motion capture information gathered by the remote sensors.
- **Stimuli heatmap**: a novel tool meant to assist in the research of SSD. It allows to record the interaction of the user with the virtual environment through any chosen SSD within a configurable time window. Note: it can only be triggered if there is at least one SSD loaded.



- **Recording**: it saves the user's movement and VES configuration (virtual environment, SSD used and its configuration...) in an external JSON file.

## References

1. Real, S.; Araujo, A. VES: A Mixed-Reality System to Assist Multisensory Spatial Perception and Cognition for Blind and Visually Impaired People. *Appl. Sci.* **2020**, *10*, 523.
2. Meijer, P.B.L. An Experimental System for Auditory Image Representations. *IEEE Trans. Biomed. Eng.* **1992**, *39*, 112–121.