Neuro-TARDIS

Visualization of an Spiking Neural Network in VR

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Introduction & Aims

The ***major aims*** were: introducing other modalities in the existing application, improving the representation and re-designing some interactions.

Neuroscientists currently base their work on a 2D raster plot that maps the neuron's activation to their timestamps. The hierarchical division of neurons is quite hard to detect as is the detection of patterns. Our goal was to provide aid in the visualization of and interaction with the structures and their grouping.

- Pyramid Cells
- Basket Cells
- Minicolumns
- Hypercolumns

Background

What we had:

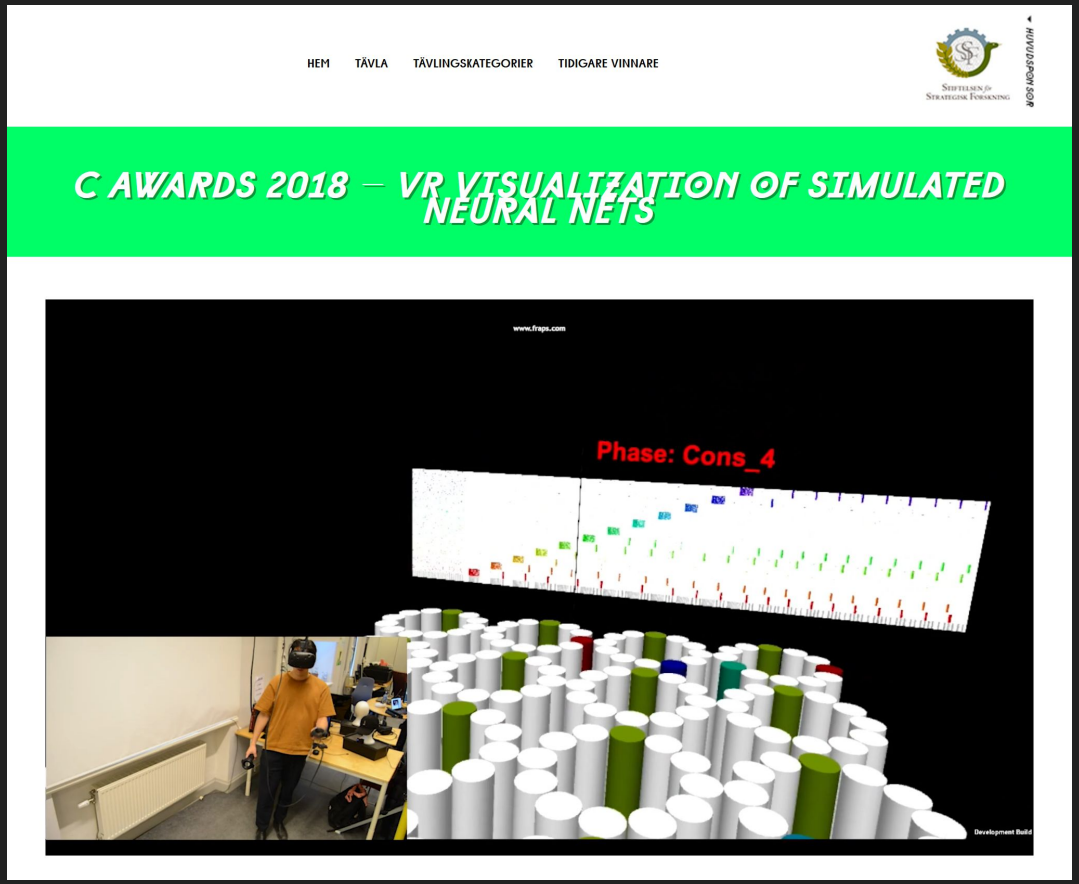
- VR application made with Unity
- Json data
- Background study on SNN

What we decided to implement:

1. Spatial audio
2. Improved visual representation
3. Remapped controls

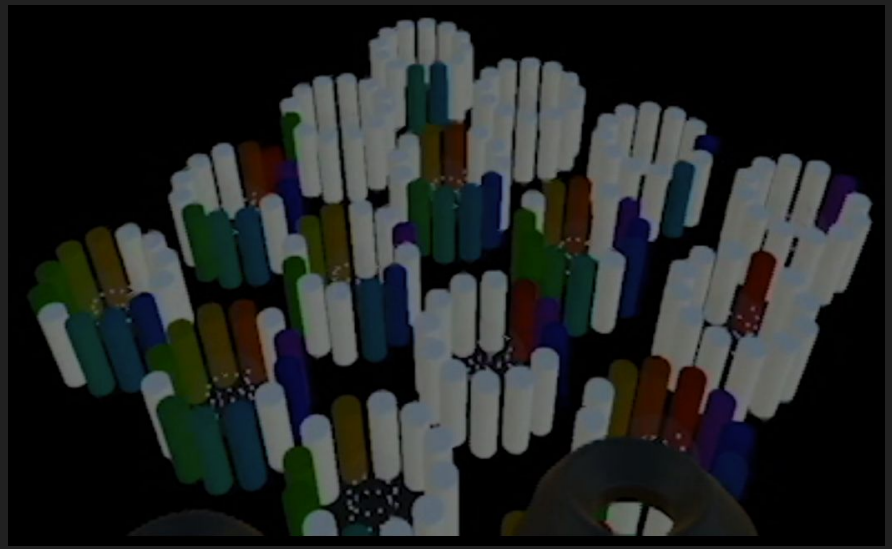
What we used:

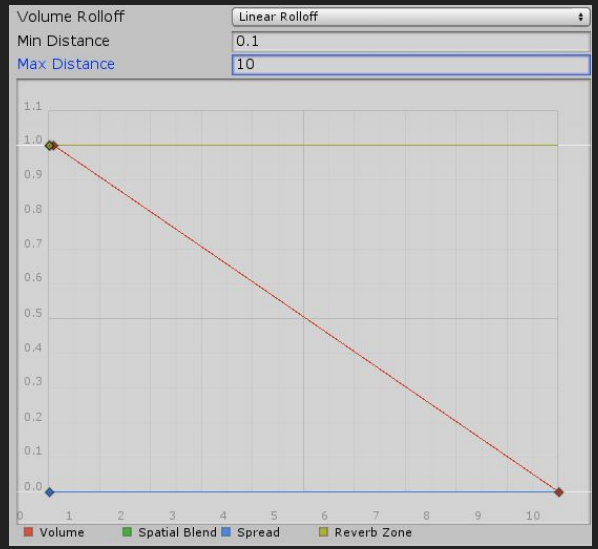
- Unity
- HTC Vive
- Ableton & Audacity



1. Audio

- Hearing is great for *identification* and *localization*
- Head-tracking VR-products enable rich *spatial audio*
- To support visual processing, the audio must be carefully calibrated
  - Type of sound
  - Duration
  - Volume roll-off distance



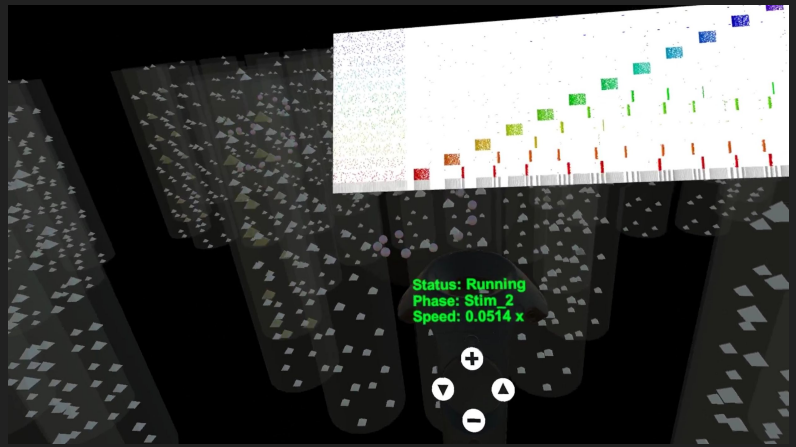


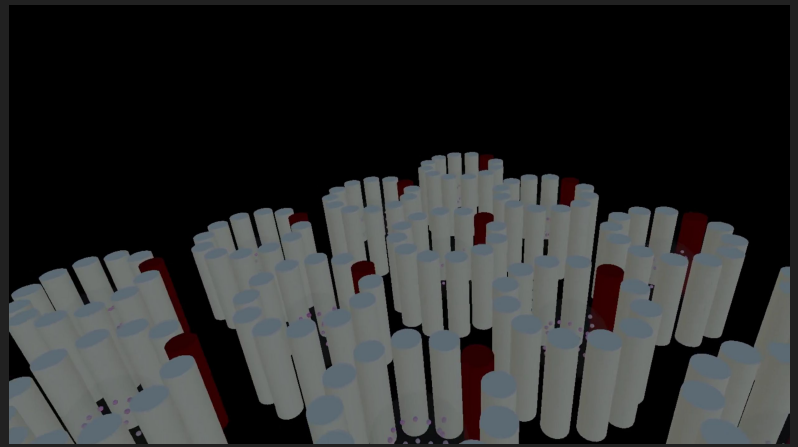
2. Improved visual representation

Every change made aims at improving the overall usability of the visualization. Two main views has been implemented, each of them with a switchable MC opacity (opaque-transparent). Both pyramids and basket cells were repositioned to make the scene less cluttered.

A current speed label has been added above the left trackpad, in addition to the currently existing status and phase labels.

Finally, a 2D scatter plot, which can be toggled on/off, has been added on the left controller to enable quick and portable comparisons between the 3D visualization and the graph obtained from the simulation.





3. Remapped controls

The user's physical movement has been better aligned with the virtual one, and rotation of the view has been re-implemented. The controllers have been remapped for a more precise navigation throughout the whole animation, redundant hot-keys were added to improve the efficiency while not using the VR headset.

Compromises on rotation, movement and playback speeds were made, to provide the best user experience we could afford.

Evaluation

It has had the opportunity to evaluate our project with ***SMEs*** in Neurosciences, ***Anders Lansner*** and ***Pawel Herman***:

What they liked:

- Sound combined with colours to recognize patterns
- Different views are efficient when it comes to analyze
- The zoom function was exactly what they wanted

What they did not like:

- Lack of landmarks useful to the orientation inside the cluster

Other feedback got from students and from ***Vincent Wong*** too:

What they liked:

- (Vincent): the interaction was improved and the overall efficiency was better
- Pretty cool, but a bit confusing since they did not know what it meant

What they did not like:

- Some interactions were unnatural and not straightforward to use

Video

Thank you for the attention.
Questions?