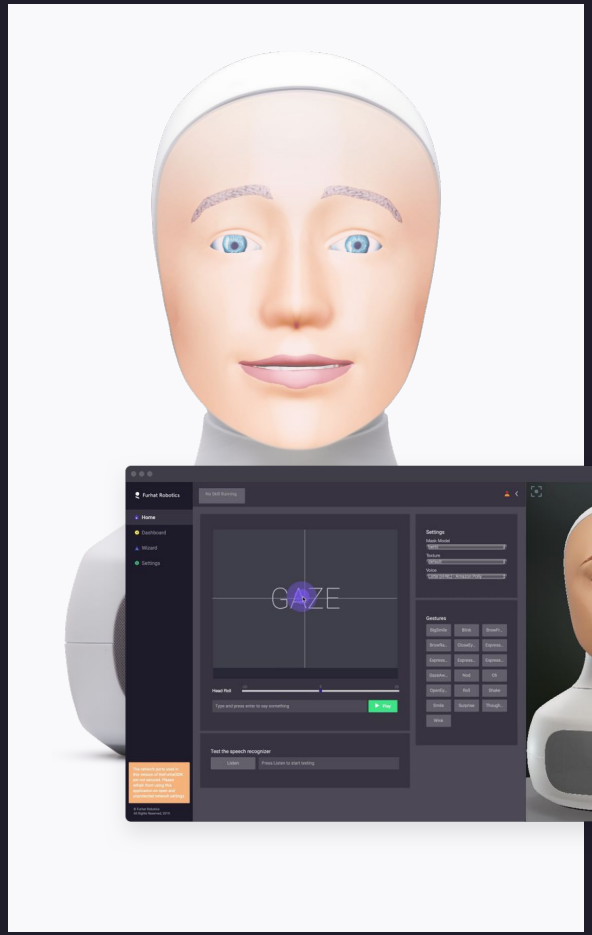
Furhat Robotics

# Comparison of Virtual Furhat and the Furhat Robot



The Virtual Furhat, in its current form, is intended to be used for development purposes for simulating interactions with the Furhat robot.

The Virtual Furhat is the main component of the SDK and consists of a head animation, an emulator for running interactions and the dashboard for monitoring and wizarding an interaction, as well as simulating users.

The Virtual Furhat is in many aspects a replica of the physical robot. The software for the skill framework running furhat applications (skills) is identical, the software for the 3D model are both running on Unity, and the web console for managing the robot, monitoring and wizarding the interaction is very similar.

Platform releases for the SDK (including the Virtual Furhat) and the Robot are released in parallel with the same version number.

The key difference between the Virtual Furhat and the Furhat Robot is that the Virtual Furhat does not support a camera stream. All visual user sensing has to be simulated in the web console dashboard.

See the tables below for a detailed view on the differences.

# Input / Sensing

## Input / Sensing

| Modality | Component | For? | Virtual Furhat | Furhat Robot |
|---|---|---|---|---|
| **Video** | Camera | Computer Vision | n/a | RGB Camera |
| | Stream video | External Computer vision processing | n/a | Yes |
| | Face Detection and Tracking | Detecting and tracking users | No, can simulate in dashboard | Yes |
| | Face Reidentification | Short term memory of users | No | Yes |
| | Face identification | Long term memory of users | No | Available on request |
| | Head pose estimation | User attention estimation | No, horizontal pane can be simulated in dashboard | Yes |
| | Face gesture detection | Emotion estimation | No | Yes. Happy (smile) and sadness. |

## Input / Sensing

| Modality | Component | For? | Virtual Furhat | Furhat Robot |
|---|---|---|---|---|
| **Audio** | Microphone | Picking up speech | Plug&Play any USB mic | Microphone array / built-in microphones / Plug&Play any USB mic |
| | DirectionOfArrival | Speaker detection | No | Yes - with Microphone Array |
| | Noise Canceling | Noise Canceling | Depends on mic used | Yes - with Microphone Array |
| | Speech Recognition | Listening | Yes, cloud | Yes, cloud |
| | Natural Language Understanding | Understand meaning/intention | Yes | Yes |

# Output / Acuating

## Output / Acuating

| Modality | Component | For? | Virtual Furhat | Furhat Robot |
|---|---|---|---|---|
| **Face** | Furhat Face Engine | 3D modeling | FaceCore (Unity) | FaceCore (Unity) / OSG[legacy] (Open Scene Graph) |
| | Projection system | Accurate representation of shadows, colors and lighting. | No simulation of projection* | Yes |
| | Mask (3D model) | Different face masks | Adult, Adult [legacy]<br>Anime [legacy] | Adult, Adult [legacy]<br>Anime [legacy]**<br>Dog [legacy]**<br>Child [legacy]** |
| | Character (texture) | Different faces | 14 Characters for adult<br>10 characters for adult [legacy] | 14 Characters for adult<br>21 characters for adult[legacy]<br>1 character for child[legacy]<br>1 character for dog[legacy]<br>1 character for anime[legacy] |
| | Facial Parameters | Facial Expressions | Yes | Yes |
| | Lip syncing | Lip syncing | Yes | Yes |

* If you shine a light at Virtual Furhat, the visibility of the face will not be impacted but the shadows on the face will be impacted. If you shine a light at the physical robot it will have the opposite effect, shadows in the 3D modeling will not be affected but the visibility of the face will be washed out.
** Currently (2022-04-05) only available on OSG [legacy] Face Engine, not the new FaceCore face engine.

## Output / Acuating

| Modality | Component | For? | Virtual Furhat | Furhat Robot |
|---|---|---|---|---|
| **Head** | Articulation | Natural head movements | Three degrees of freedom. Slight different pivot point resulting in slight increased neck articulation compared to Furhat Robot. | Three degrees of freedom. Small effect of dynamixel motors and inertia slowing down head movements compared to Virtual Furhat. |

## Output / Acuating

| Modality | Component | For? | Virtual Furhat | Furhat Robot |
|---|---|---|---|---|
| **Voice** | Speakers | Speaking | plug&play | Built-in Stereo speakers / plug&play |
| | TTS | Speaking | Amazon Polly (cloud) | Amazon Polly (cloud) + Acapela (on-board) |

## Output / Acuating

| Modality | Component | For? | Virtual Furhat | Furhat Robot |
|---|---|---|---|---|
| **Conversation** | Skill framework | Conversation modeling | Kotlin Skill API,<br>Blockly,<br>Remote API | Kotlin Skill API,<br>Blockly,<br>Remote API |
| | Logging | Speaking | Yes | Yes*** |

*** Logs that are written to the cloud are always available. Logs that are written to the harddrive are not accessible unless the interaction is run from a developer computer on the Furhat robot.

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