

Avatar Builder

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INTRODUCTION

This step-by-step guideline introduces **Avatar Builder**, a framework designed to help users create and animate 3D avatars for virtual experiences and for multiple visualisation platforms.

No prior experience in 3D modelling or animation is required. The guide focuses on **practical actions and clear instructions**, allowing curators, educators, and content creators to concentrate on storytelling and interpretation rather than technical complexity.

By following this guide, you will be able to:

- Create a digital human character
- Animate the character using pre-made motions
- Reuse the same avatar across multiple virtual platforms

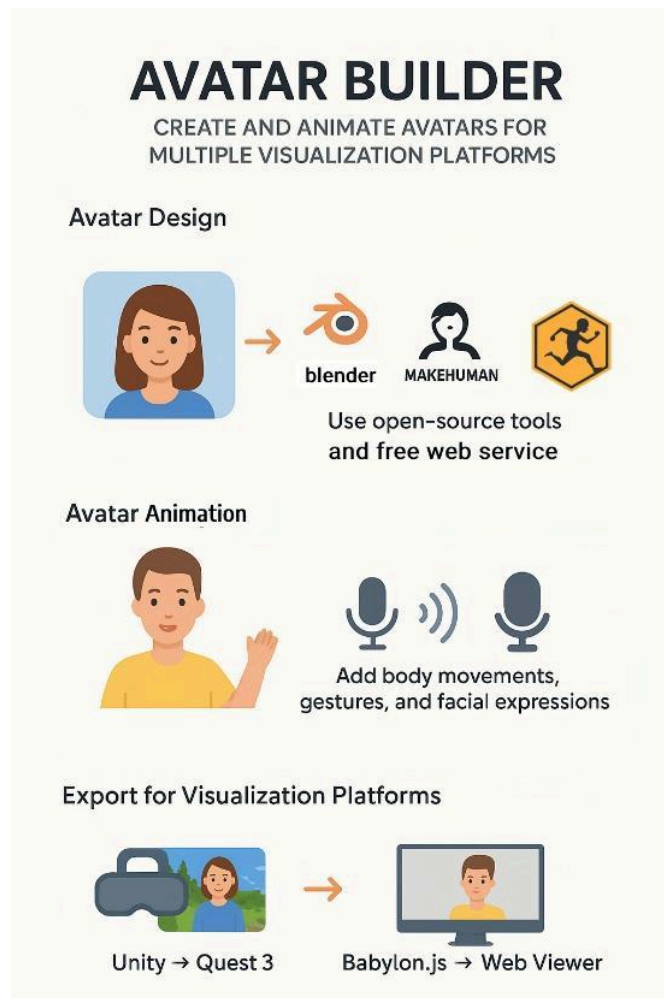


Figure 1 The framework

THIS GUIDE IS INTENDED FOR

- Cultural Heritage Professionals
- Creative and XR professionals
- Or anyone else interested in creating digital characters for virtual experiences
- No programming skills or technical background are required.

TOOLS AND SOFTWARE USED IN THIS GUIDE

- [MakeHuman](#): for creating the avatar's body, face, and clothing (To install on your computer)
- [Mixamo](#): a web-based service to add animations to your avatar
- [Blender](#): for refining and preparing the avatar for export for visualisation (To install on your computer)
- [Unity Hub](#) is necessary to streamline the management of multiple Unity Editor versions, projects, licenses, and module installations (like Android/iOS support) in one centralised location. While not strictly required to run a single version of the editor, it is the official, recommended tool for managing installations, projects, and licensing, providing a "gateway" to the Unity ecosystem

For our Demo, we are using Unity version **2022.3.7f1**

Note: Use the latest stable versions of MakeHuman and Blender. Mixamo works directly in your browser, no installation is needed.

BEFORE YOU START, YOU WILL NEED

1. A computer

- Windows, macOS, or Linux
- Internet access

Note: A computer with a good graphics card will make Blender run faster, but it's not strictly required for simple avatars.

2. Installation of the software tools

- Install MakeHuman.
 - Go to [Releases](#) and follow the instructions provided here.
- Install Blender on your computer.
- Mixamo is a web-based tool and does not need installing.

3. Optional materials

- Reference images, sketches, or descriptions of your character
- Headphones or speakers if you want to preview animations with sound

PREPARATION OF YOUR MATERIALS AND WORKSPACE

- **Organise folders for each project:**
 - Raw character files

- Refined Blender files
- Animated files from Mixamo
- Exported character, FBX folder and GLB folder

OVERVIEW OF THE WORKFLOW

Creating an animated avatar involves four main steps, each supported by free and accessible tools. Users will create the character with MakeHuman, refine its appearance with Blender, add movement in Mixamo and finally export it for VR, AR, or web-based platforms.



Figure 2 Overview of the workflow

STEP-BY-STEP GUIDELINES

STEP 1: AVATAR DESIGN

WHAT IS MAKEHUMAN?

MakeHuman is a free and open-source 3D computer graphics software used to create realistic virtual human characters for use in other projects like video games or animations. It uses a graphical user interface with sliders to control macro-level attributes like gender, age, height, and weight, and detail-level features for facial and body parts. Users can then export their creations in various formats to other 3D programs like Blender or Mixamo.

The software is developed by a community and supports sharing resources like clothing, poses, and rigs.

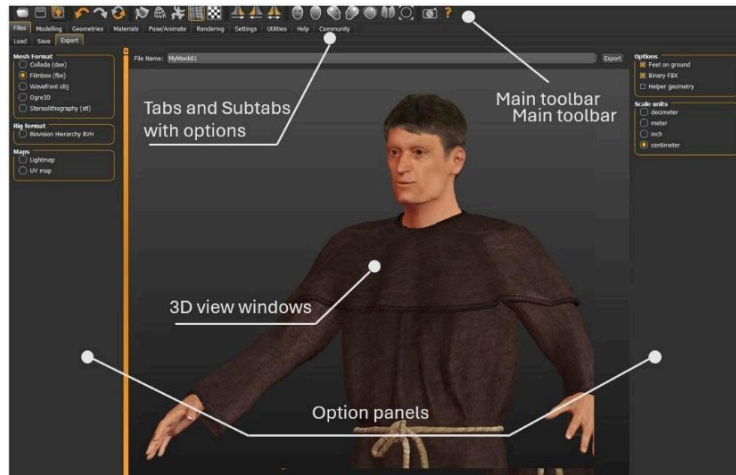


Figure 3 MakeHuman interface

Using Your Mouse in 3D

The mouse plays an extremely important role in 3D. With the mouse users can move pieces on the model, zoom in/out, move the model, rotate, pan, etc.

The following diagram demonstrates the way to navigate with the mouse.



HOW TO CREATE AN AVATAR IN MAKEHUMAN?

1. Launch MakeHuman

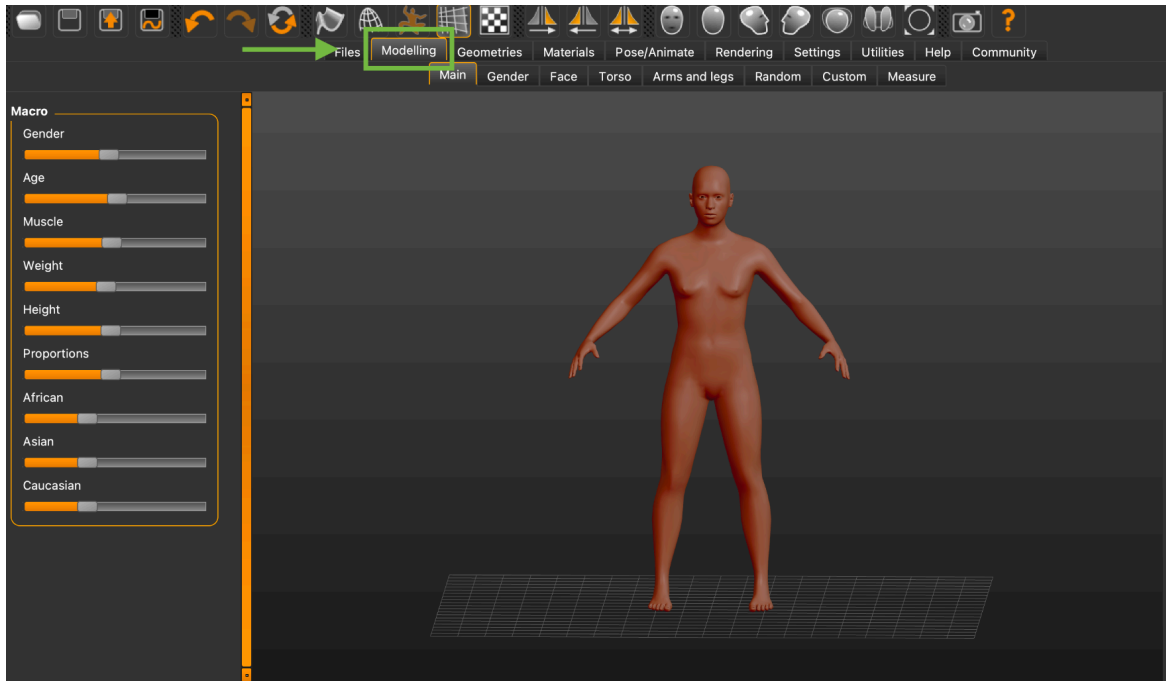
Open the MakeHuman software. The workspace will display a default human model.

2. Set Base Parameters

Go to the Modelling tab.

In the Modelling tab, adjust the avatar's basic characteristics:

- a. Gender: Male or Female
- b. Age: Child, Teen, Adult, or Elder
- c. Height and Weight: Modify overall body proportions



3. Customise Body Features

Refine body details in the Body section by adjusting:

- a. Muscle tone
- b. Chest, arms, and legs size
- c. Torso and hips proportions
- d. Fingers, hands, and feet if needed

4. Adjust Facial Features

In the Face tab, modify facial structure, including:

- a. Eyes (shape, size, spacing)
- b. Nose (length, width, angle)
- c. Mouth and lips (shape, thickness)
- d. Ears (size, position)
- e. Jaw and cheeks



Figure 4 Customising the body and the face

Customising the body and face in MakeHuman is a key step in creating a realistic and personalised avatar.

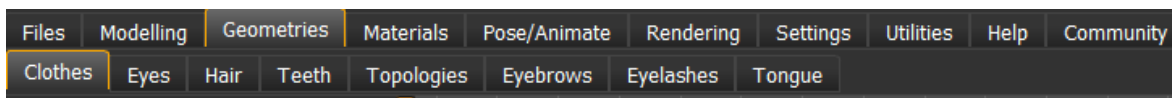
The software provides intuitive sliders that allow you to precisely adjust body proportions such as height, weight, muscle definition, chest, arms, legs, torso, and hips. At the same time, detailed facial customisation options enable fine control over features including the eyes, nose, mouth, ears, jaw, and cheeks. These tools make it possible to shape both the overall physique and the facial identity of the avatar.

5. Add Clothing and Accessories

Clothes and hairstyles can be added to the avatar through the Clothes and Hair sections, where available assets can be applied directly to the model. For more variety and customisation, you can access the Community tab, which provides a large collection of **clothing and hair models created by the MakeHuman community**. Within this tab, filtering options and keyword search tools allow you to quickly find specific types of clothing or hairstyles, such as jackets, shoes, dresses, or particular hair styles. Once selected and downloaded, these assets can be easily applied to the avatar.

In the Clothes or Geometries tab:

- a. Select clothing items such as shirts, pants, and shoes
- b. Adjust size and fit to match the body shape



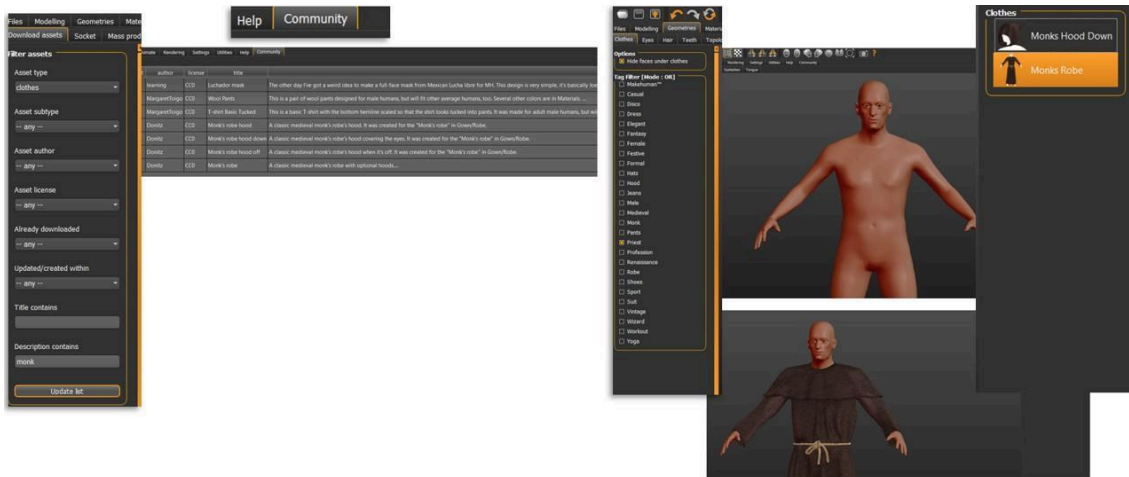


Figure 5 Clothing the avatar

6. Select Skin and Hair

In the Appearance or Materials section:

- a. Choose skin tone and complexion
- b. Select hair style and color
- c. Set eye color and add eyelashes if desired

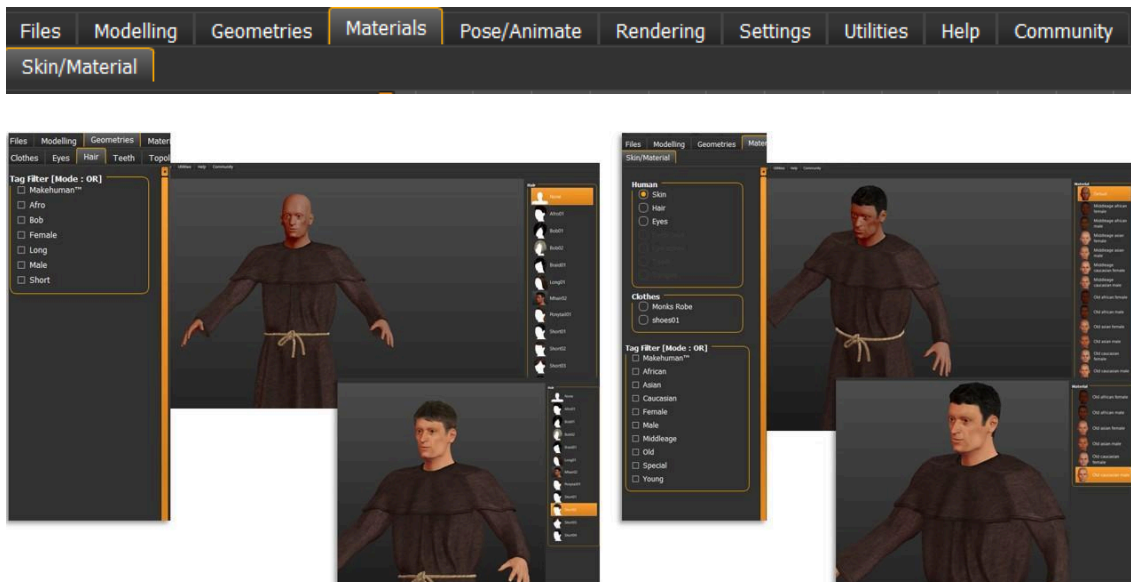


Figure 6 Adding hair and customising the skin

7. Pose and Expression (Optional)

Use the Pose/Animate tab to:

- a. Change the avatar's pose
- b. Add facial expressions if required

The Pose and Expression (Optional) tab in MakeHuman allows us to define how the avatar appears in a static or dynamic state. **If you want to create a static avatar** with a specific body pose and facial expression, this tab provides predefined poses and expression controls that can be applied easily. By selecting an appropriate pose, you can adjust the posture of the avatar to match the intended presentation, while facial expression options help convey emotions or character personality. This is especially useful when the avatar is intended for visualisation, presentation, or reference purposes rather than animation.

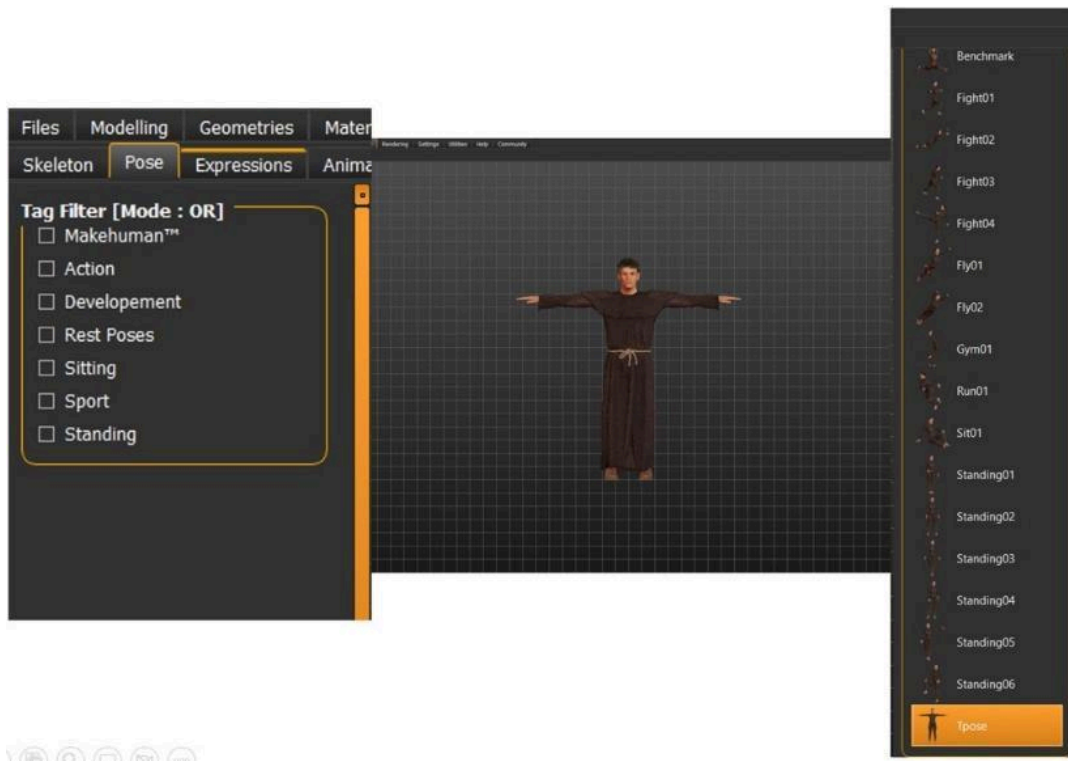


Figure 7 Putting the avatar in a T posture

If the avatar is intended for further animation in Mixamo or other animation software, it is recommended to assign a T-pose to the model (Figure 7). A T-pose places the arms extended horizontally and the body in a neutral position, which helps facilitate the rigging process by allowing the software to correctly detect joints and body proportions. Using a T-pose ensures better compatibility with automatic rigging systems, reduces animation errors, and results in smoother and more accurate animations.

8. Preview the Avatar

Rotate and zoom in the 3D view to check the avatar from different angles. Make any necessary final adjustments.

9. Save and Export

- a. Save the project via **File** → **Save** for future editing.
- b. Export the avatar for use in other applications via **File** → **Export**, choosing the desired format (obj, .fbx, .dae).

The Export Options in MakeHuman allow the user to save the completed avatar in formats compatible with external 3D and animation software. **For animation purposes**, the most commonly used formats are FBX and OBJ. Exporting the model in FBX format is recommended when the avatar will be uploaded to Mixamo, as this format supports proper geometry and skeletal data required for automatic rigging and animation. Alternatively, the OBJ format can also be used, mainly **for static models or further editing**, although it does not include rigging information by default. By exporting the avatar in FBX or OBJ format, you can easily import the model into Mixamo, apply animations, and then reuse the animated character in games, simulations, or other 3D applications.



Figure 8 Export options

STEP 2: AVATAR ANIMATION

WHAT IS MIXAMO?

Mixamo is a web-based animation platform developed by Adobe that enables you to easily rig and animate 3D characters without requiring advanced animation skills. It works by automatically generating a skeleton for an uploaded character model and binding it to the mesh through an intuitive auto-rigging process. Once rigged, the user can choose from a wide range of predefined animations such as walking, running, jumping, or idle movements. These animations can be previewed, adjusted, and applied directly to the avatar. This process enables quick and efficient animation creation, making the avatar suitable for use in games, virtual reality environments, simulations, or other interactive applications.

Mixamo is a free service, requiring only an Adobe account to sign in.

PROCESS OF ANIMATING THE AVATAR IN MIXAMO

This step-by-step process allows users to quickly transform a static 3D character into a fully animated model using Mixamo.

1. Access Mixamo

Open a web browser and go to the Mixamo website. Sign in using an Adobe account.

2. Upload the Character

Click on the Upload Character button and select your exported FBX or OBJ file. Mixamo will load the model into the interface.

3. Set Rigging Markers

Once the model is uploaded, Mixamo will ask you to **place markers on key body parts**, such as the chin, wrists, elbows, knees, and groin. These markers help Mixamo understand the character's anatomy. After placing the markers, click Next. Mixamo will automatically generate a skeleton and rig the character. This process usually takes a few moments.

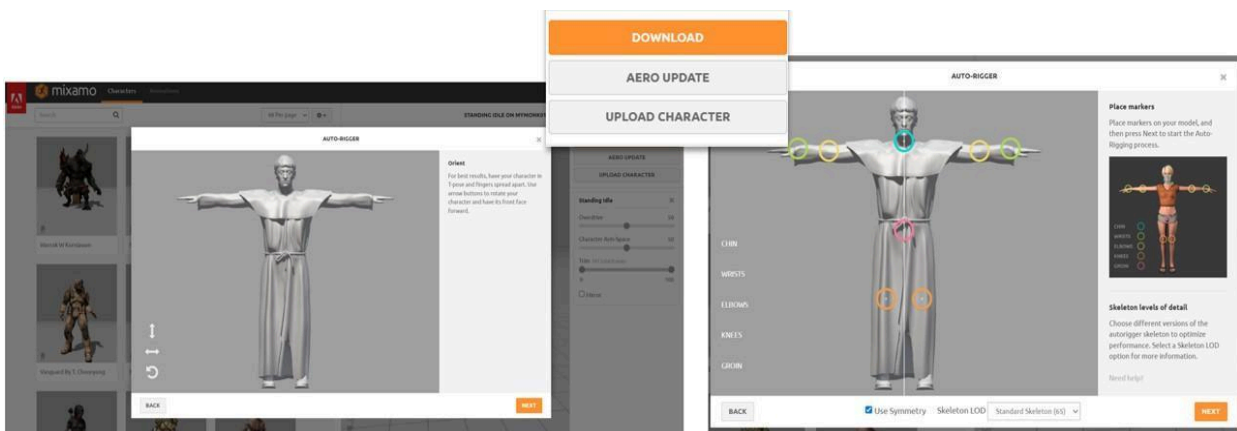


Figure 9 Upload and rig the avatar in Mixamo

4. Choose an Animation

After rigging is complete, **browse the animation library** available in Mixamo. **Select an animation** such as walking, running, jumping, or idle movements. The animation will be applied to the character and previewed in real time.

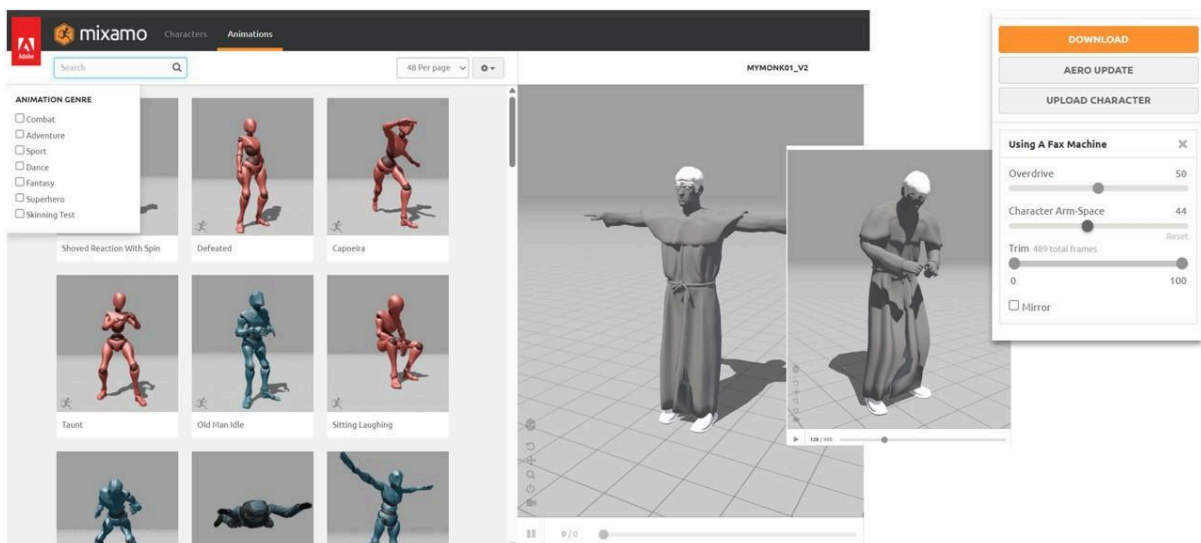


Figure 10 Choosing and adjusting an animation

5. Adjust Animation Settings

Use the available controls to modify the animation parameters, such as speed, arm spacing, or movement intensity, to better suit your needs.

6. Download the Animated Character

Once the animation has been finalised, the user downloads the animated character from Mixamo by clicking the Download button.

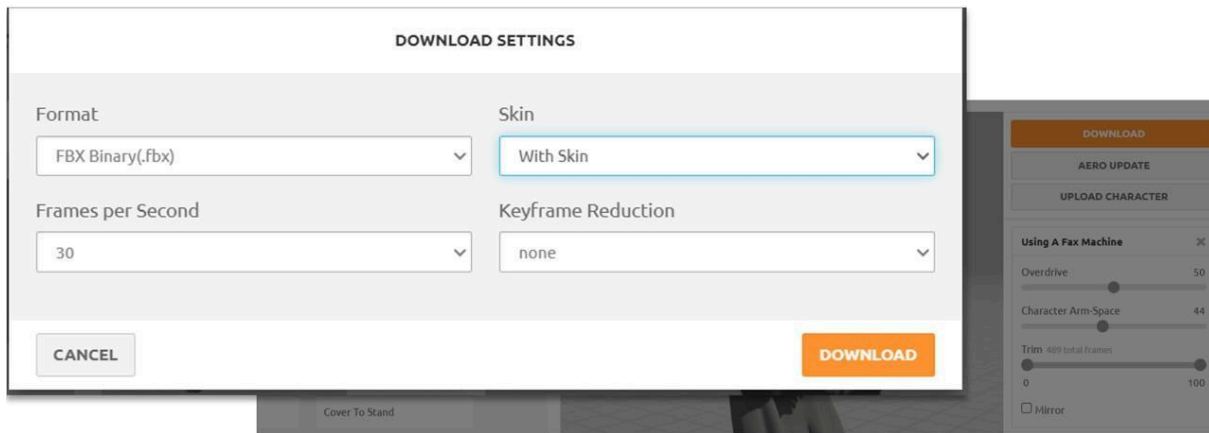
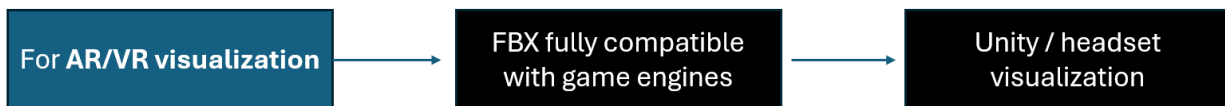


Figure 11 Downloading the animated avatar

7. Preparation and Conversion for Final Platform Use

The downloaded animated character is then prepared for its final use depending on the target platform:

The FBX format with skin is the most appropriate option, especially for virtual reality (VR) applications, as it includes both the character mesh and the animation data in a format that is fully compatible with game engines such as Unity. This ensures that the animated avatar can be directly imported and used in immersive VR environments without additional rigging or adjustments.



For web visualisation, the FBX file must be converted into a GLB (glTF binary) format, which is more efficient and widely supported by web-based 3D viewers.

This conversion is typically done by importing the FBX file into Blender, where materials, scale, and animations can be checked before exporting the model as a GLB file. This process ensures optimal performance and compatibility for displaying the animated avatar on the web.



STEP 3: AVATAR FORMAT CONVERSION IN BLENDER

Blender is a free, open-source 3D creation software used for modeling, texturing, animation, and file format conversion. It is commonly used as an intermediate tool to prepare and optimise 3D assets for different platforms.

To convert an animated character from Mixamo into a web-friendly format, the user can import the FBX file into Blender by selecting **File** → **Import** → **FBX (.fbx)** and choosing the downloaded Mixamo file. (Figure 12)

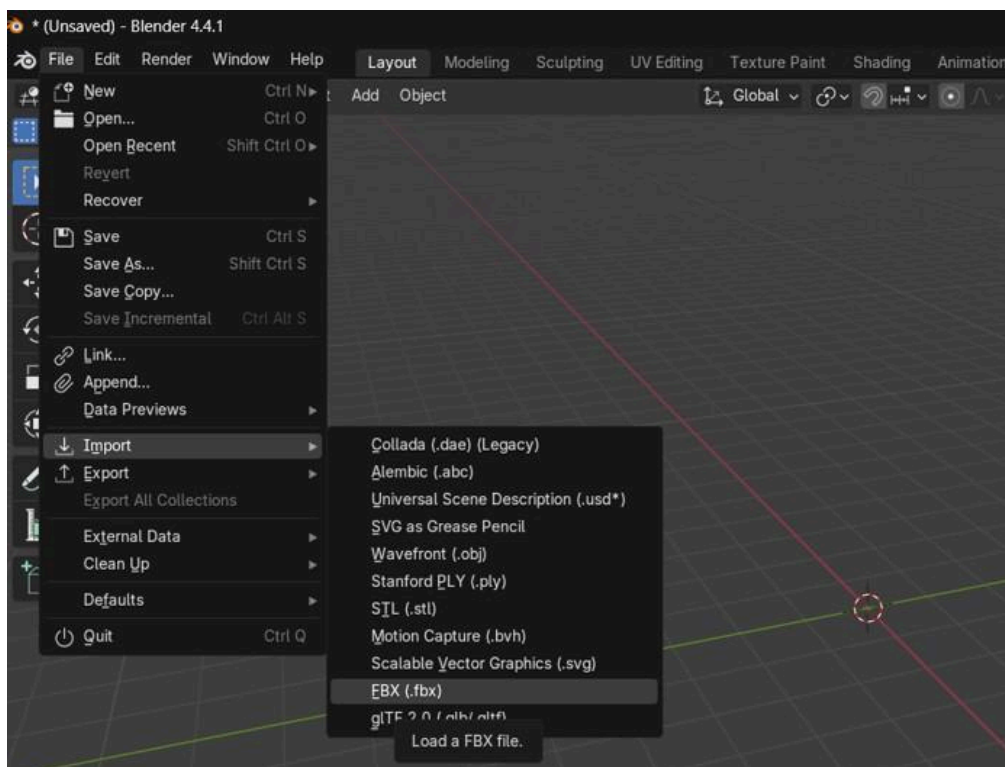


Figure 12 importing the FBX into Blender

Once imported, the character, including its mesh, materials, and animations, can be reviewed and adjusted if necessary.

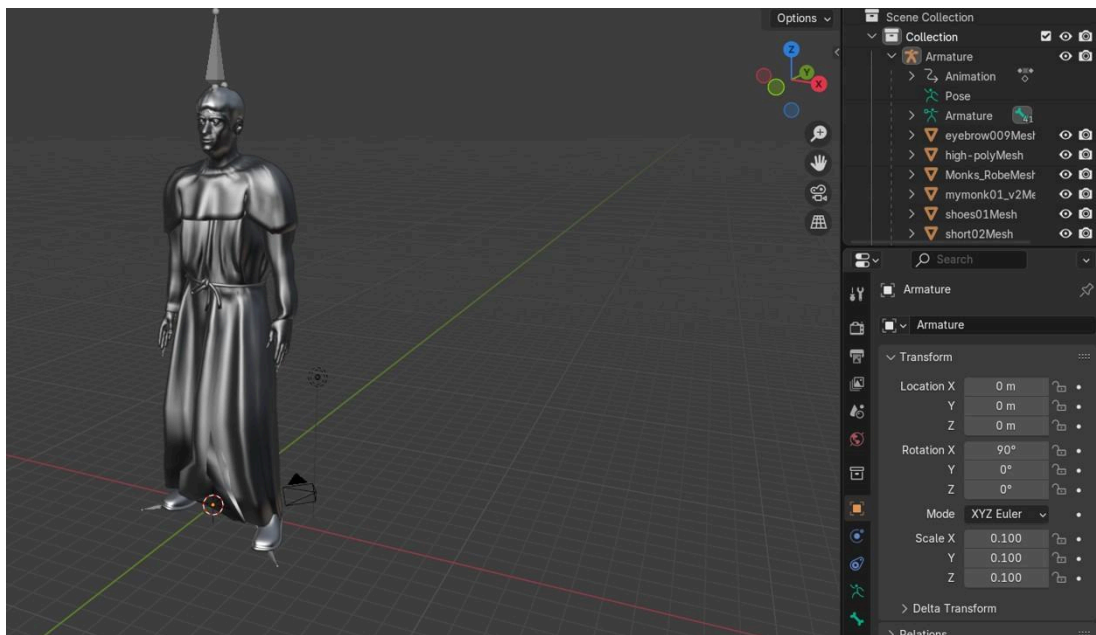
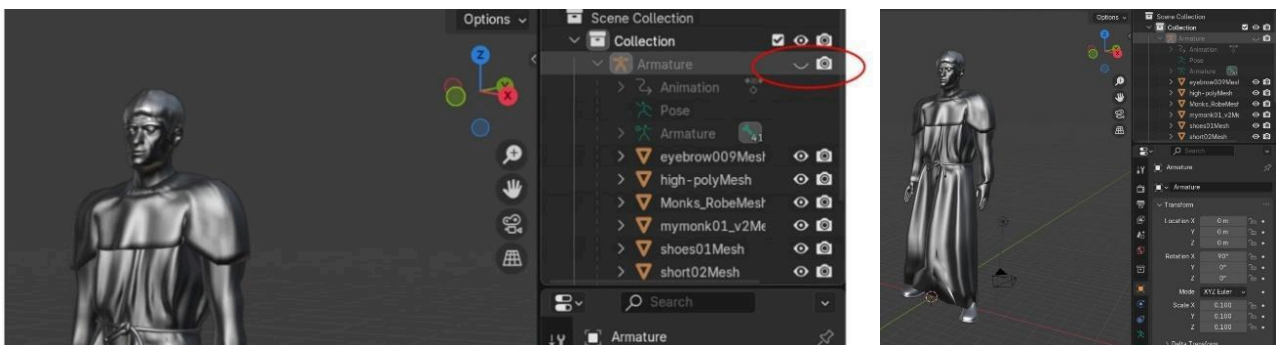


Figure 13 The imported FBX in Blender

Note: To avoid visual distraction, you can hide the skeleton from the right-side panel.



Important: A very common issue when importing FBX files from Mixamo into Blender and is usually related to how materials and textures are interpreted.

When the model looks metallic or shiny, Blender is often assigning incorrect values to the Principled BSDF shader.

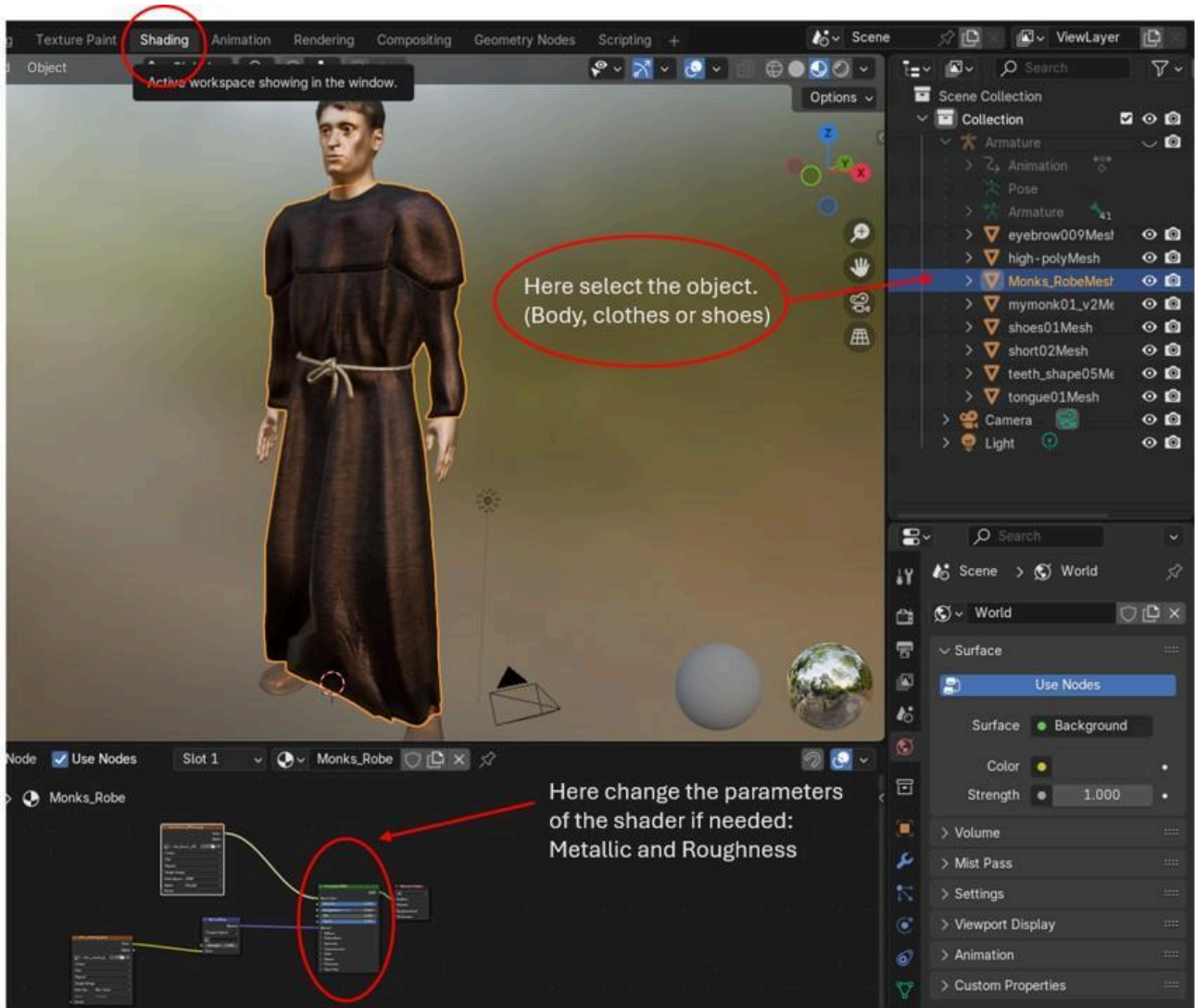


Figure 14 Retrieving the correct colors

To retrieve the correct colors, follow these steps:

1. Check the Material Shader

- a. Select the character mesh.
- b. Go to the Material Properties panel.
- c. Make sure the material uses a Principled BSDF shader.

2. Reconnect the Texture Properly

- a. Open the Shader Editor.
- b. If the texture is not connected correctly, add an Image Texture node.
- c. Load the character's diffuse/albedo texture and connect it to the Base Color input of the Principled BSDF shader.

3. Adjust Metallic and Roughness Values

- Set Metallic to 0.0 (this usually fixes the metallic look).
- Increase Roughness to around 0.5–0.7 for a more natural skin or fabric appearance.

4. Check Viewport Shading Mode

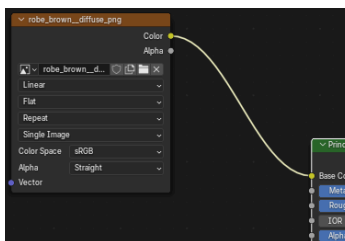
- Switch to Material Preview or Rendered mode to see accurate colors.
- In Solid mode, colors may appear incorrect or flat.



5. Verify Texture Color Space

- Select the Image Texture node.
- Set Color Space to sRGB for color (diffuse) textures.

Note that when you export your model from MakeHuman in FBX, a folder containing the textures will be created. This is in case you need to reload your texture in Blender.



6. Apply or Reassign Materials if Needed

- If multiple materials are present, ensure each mesh part has the correct material assigned.

After these adjustments, the avatar's colors should appear natural again. This step is especially important before exporting the model to GLB for web visualisation, as correct materials ensure proper rendering across platforms.



Figure 15 The 3D model after shader adjustment

STEP 4: FACIAL ANIMATION (OPTIONAL) IN BLENDER

Instead of relying on external add-ons, **basic facial animation can be achieved directly within Blender** using shape keys. Shape keys are predefined facial deformations included in the MakeHuman character, allowing simple control over expressions such as mouth opening, smiling, or blinking. This method works consistently across Blender versions and does not require any additional installation.

After importing the animated character (with body animation from Mixamo), users can enhance realism by adding a few key facial movements. For example, blinking can be created by animating eyelid shape keys at regular intervals, and simple mouth movements can be added by keyframing different mouth shapes over time. Although this approach does not provide precise lip synchronisation, it is sufficient to give the character a more natural and expressive appearance.

This simplified method ensures that the workflow remains easy to follow, robust, and suitable for non-technical users. It also keeps the pipeline fully compatible with modern Blender versions while still allowing users to experiment with basic facial animation techniques.

Once both body animation (from Mixamo) and basic facial animation (using shape keys) are completed in Blender, the character can be exported for use in different visualisation environments.

If the animation includes audio (for example, speech or narration), the sound file should be placed in the same folder as the exported 3D file. This ensures proper organisation and makes it easier to link the audio with the animation in the target environment.

This method allows simple facial expressions such as blinking and basic mouth movement to enhance the animated character.

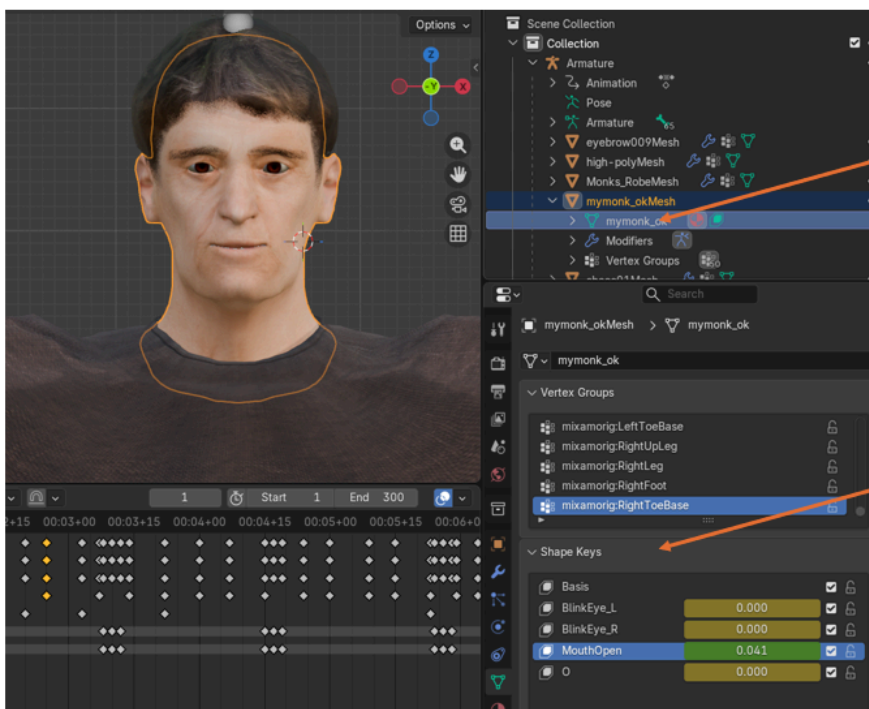
Quick Steps: Adding Basic Facial Animation in Blender

1. Select the character mesh (face)

In the 3D View, click on the character's head or body mesh.

2. Open Shape Keys

Go to Object Data Properties (green triangle icon) → Shape Keys.



Select the head geometry

Creating Shape Keys

3. Create a blink animation

- Locate eyelid shape keys (e.g. Blink, EyeClose)
- Set Value = 0 at frame 1 → Right-click → Insert Keyframe
- Move to frame 10 → Set Value = 1 → Insert Keyframe
- Move to frame 20 → Set Value = 0 → Insert Keyframe
- Repeat later in the timeline for natural blinking

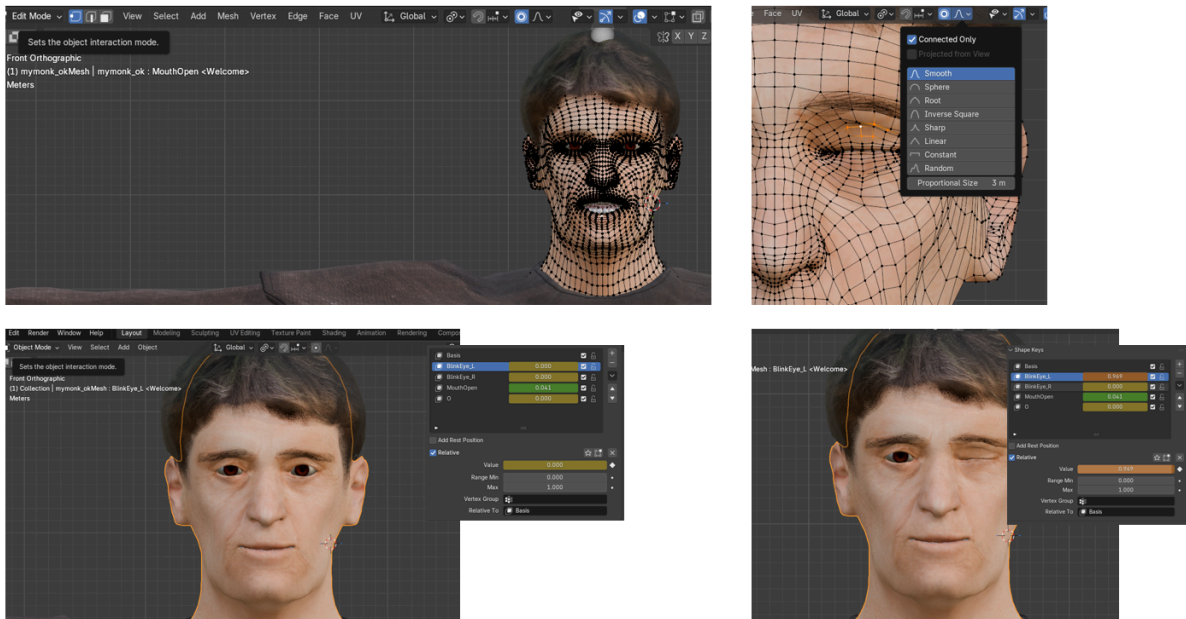
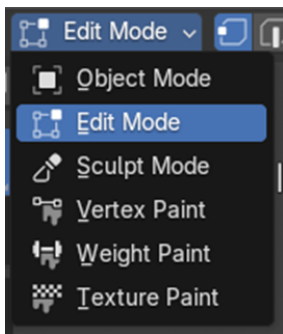


Figure 16 Modify the geometry points

To modify the geometry points and shape the facial expression, **switch to Edit Mode**. In this example, we are creating a blinking animation for the left eye. (Figure 16)



4. Create simple mouth movement

Mouth movements (such as opening the mouth) are created using the same method as blinking eyes, by modifying the relevant shape keys in Edit Mode and keyframing their values.

- a. Select a mouth shape key (e.g. MouthOpen, A, O)
- b. At different frames, change the Value (0 → 1 → 0)
- c. Insert keyframes to simulate speaking

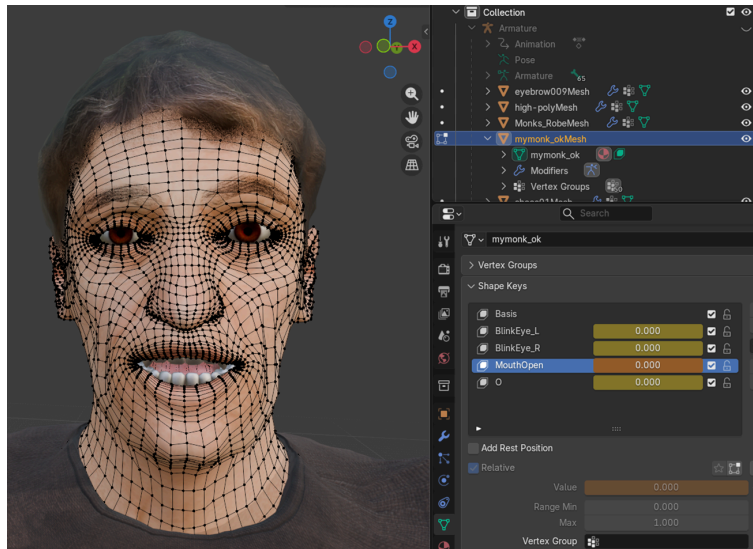


Figure 17 Creating Shape key for "Mouth open"

5. Animating Shape Keys for Facial Animation

After creating the required shape keys, animate their values by inserting keyframes at different frames to produce the desired facial animation.



Figure 18 keyframes inserted at different time for the different shape keys



Figure 19 The generated facial expression at different frames

6. Adding the audio file

The audio file can be loaded into the timeline, allowing the keyframes to be adjusted accordingly to simulate the character speaking in sync with the audio.

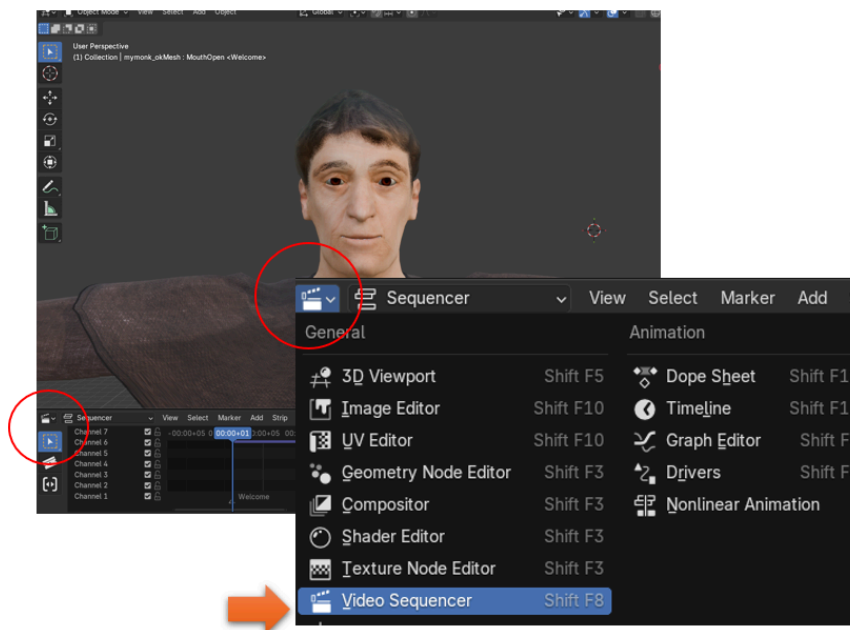


Figure 20 Adding an audio file

7. Play the animation

Press Spacebar to preview the result and adjust timing if needed.

This final step completes the pipeline, allowing the animated character to be reused across web and immersive platforms.

Further Resources for facial animation:

- [Shape Keys For Beginners](#)
- [Facial Shapekeys For Beginners](#)

After verification, the model can be exported as a GLB (glTF binary) file: **File** → **Export** → **glTF 2.0 (.glb)**.

This format is optimised for efficient loading and rendering, making it ideal for web visualisation and real-time applications while preserving animations and textures.



Figure 21 Export to GLB format

STEP 5: VISUALISATION OF THE ANIMATED AVATAR IN THE MIRALab 3D ANIMATION VIEWER

WEB-BASED VISUALISATION

MIRALab 3D Animation Viewer is a web-based 3D model viewer with advanced features including audio synchronisation, 360° panoramic backgrounds, and multi-scene support. The viewer is hosted by Eureka3D-XR github.

- a. Upload your 3D files to the EGI DataHub (<https://github.com/EUreka3D-XR>), A SHARE_ID will be automatically created for the file.
- b. In your Browser type the following URL by adding the SHARE_ID at the end:
`http://3dwebviewer.eureka3dxr.fedcloud.eu:8141/{SHARE_ID}`

The viewer will:

- a. Fetch the file from EGI DataHub
- b. Auto-detect the file type
- c. Load the appropriate viewer
- d. Display the content

Further information about the viewer can be found here: <https://github.com/EUreka3D-XR/WebAnimationViewer>

VR/MR VISUALISATION

To create a VR/MR experience, a ready-to-use Unity template is provided. (put link to data Hub)

This template already includes all the necessary technical setup (VR camera, scene, and configuration).

The Unity template is designed to hide technical complexity. Users only need to import their avatar and launch the application.

1. Open the Unity template

- a. Download and open the provided Unity project
- b. All VR settings are already configured

2. Import your avatar

- a. Export your character as FBX from Blender
- b. Drag and drop the file into the Unity project

3. Replace the example character

- a. Delete or hide the placeholder character
- b. Drag your avatar into the scene

4. Connect your headset

- a. Connect your Meta Quest 3
- b. Make sure it is recognised by Unity

5. Build and run

- a. Click "Build & Run"
- b. The application is automatically installed on the headset

Important: for users who are not familiar with tools such as Unity, a complete step-by-step user guide is available [here](#).

HELP AND MORE INFORMATION

If you require any additional help or have questions regarding the process, please feel free to contact us for support. Further assistance can be provided upon request. Additionally, a video demonstrating the same workflow described in this manual is available at the following URL, where you can view the complete process step by step for better understanding.

- Video showing the same workflow: <https://www.youtube.com/watch?v=C41Hs9EUxYY>
- Further information about the viewer can be found here: <https://github.com/EUreka3D-XR/WebAnimationViewer>

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